# BASEWIDE ENERGY CONSERVATION STUDY AND SYSTEM PLAN

## FORT HOOD, TEXAS

## FINAL REPORT

## Executive Summary

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DECEMBER 1979

PREPARED FOR

FORT WORTH DISTRICT, CORPS OF ENGINEERS

FORT WORTH, TEXAS

CONTRACT NO. DACA63-78-C-0145

PREPARED BY

BLACK & VEATCH

CONSULTING ENGINEERS

KANSAS CITY, MISSOURI

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TABLE OF CONTENTS

GENERAL

The purpose of this volume is to present a summary of the results of the Basewide Energy Conservation Study and System Plan for Fort Hood, Texas. The overall objective of this study is to develop a systematic approach to facilitate the reduction of energy consumption at Fort Hood by approximately 20 percent per square foot. However, such a study would be incomplete if the goals established by the Major Army Command (MACOM) and assigned by Presidential Executive Order 12003 and the Department of Defense were not considered. In addition, the Department of the Army has established a goal for reduction of total facility energy consumption by at least 25 percent by FY 85 and a reduction of 50 percent by FY 2000 using FY 75 as the base year. Other pertinent goals include reducing facility use of petroleum fuels by 75 percent and eliminating use of natural gas by FY 2000.

This summary presents data from the study on the following:

- Existing energy consumption
- Source energy reductions due to energy conservative techniques
- Savings utilizing central energy monitoring and control systems
- Use of alternate energy sources
- Total Energy and Selective Energy Systems
- Operational and planning recommendations.

Fort Hood utilizes electricity and natural gas as energy sources. Propane gas and some fuel oil is also used but to a very small extent

by comparison. Table 1 is a compilation of building area and annual energy consumption for FY's 1975, 1976, 1977, and 1978.

TABLE 1

Building Area and Yearly Energy Consumption
in Million Btu

| | FY 75 | FY 76 | FY 77 | FY 78 |
|---|---|---|---|---|
| Area, sf (1) | 18,255,105 | 20,001,027 | 21,064,450 | 21,060,282 |
| Electricity (2) | 2,341,777 | 2,457,939 | 2,665,730 | 2,787,636 |
| Natural Gas (3) | 1,915,128 | 1,640,550 | 1,903,111 | 1,882,306 |
| Total | 4,256,905 | 4,098,489 | 4,568,841 | 4,669,942 |

(1) FY 78 as of 30 April; all others as of 30 September
(2) 11,600 Btu per kW/hr was assumed
(3) Actual Btu from gas bills was used (FY 76 thru FY 78)
(4) FY is Oct-Sept

Since the majority of energy consumed at Fort Hood is used for environmental control, an obvious means of energy reduction is to upgrade the building envelopes and to control the operating time of the environmental control equipment. These improvements offer a large energy savings and a substantial cost reduction.

Additionally, replacing existing equipment with high efficiency equipment will often result in economically attractive energy reduction and also offer the opportunity to select the energy source desired.

In establishing their goal, the Department of the Army Advisory Group on Energy provided the following guidance on achieving the 25 percent reduction in total Army energy consumption:

| | |
|---|---|
| Energy Conservation Investment Program (ECIP) | 12% |
| Energy Management | 8% |
| New Construction | 5% |

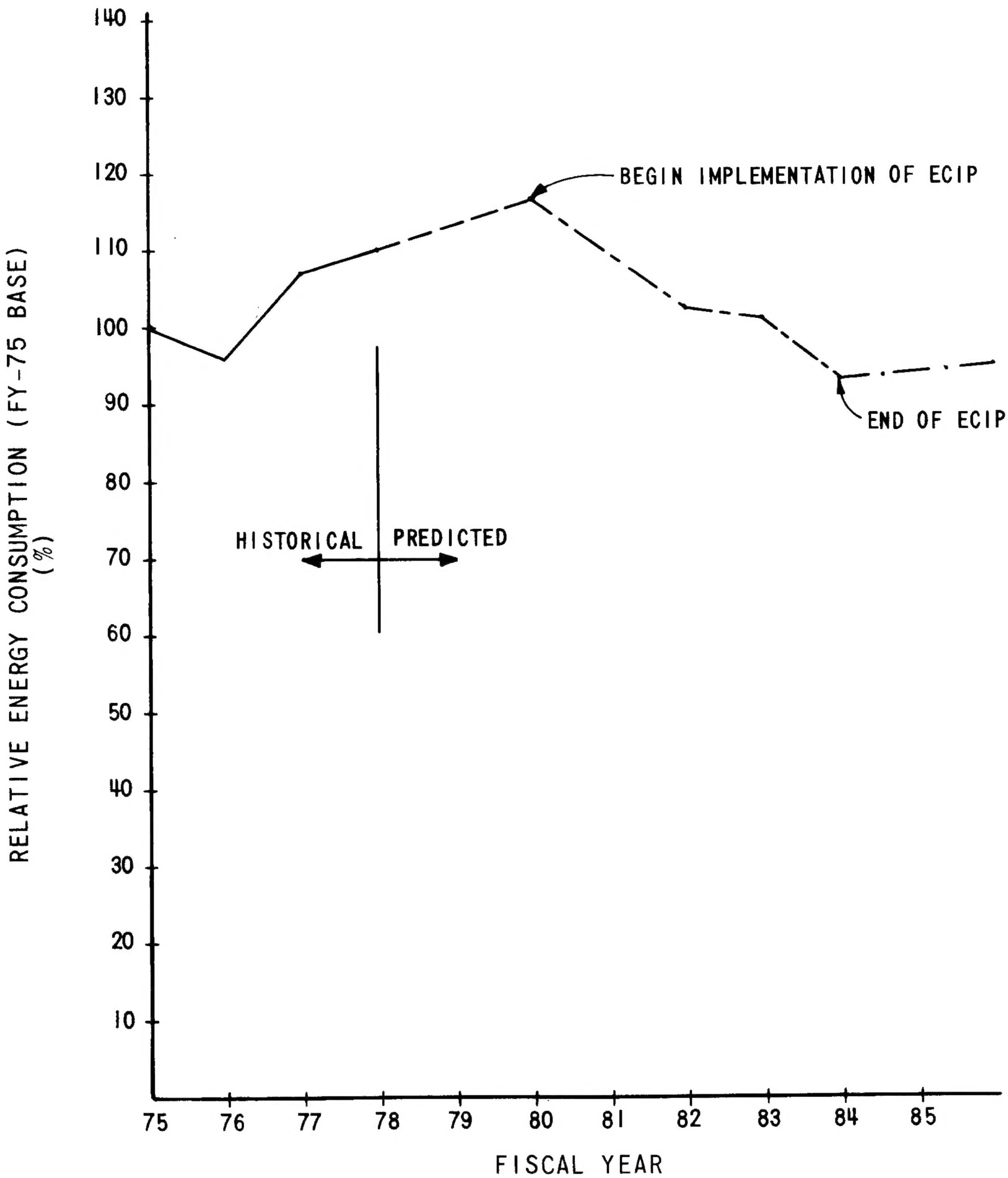
Figure 1 indicates the current status of energy consumption at Fort Hood. Since 1975, basewide energy consumption has increased at approximately 3 percent per year. Concurrently, the total building area of the post has increased at approximately 5 percent per year. There is no reason to believe that this trend toward more efficient, new buildings will be reversed, but there are indications that the increase rate of building area will be slowed or stopped within the next few years. More than 200 temporary buildings are scheduled for demolition in the next two years, indicating that the ever-expanding requirement for floor space is abating.

Implementation of the Energy Conservation Investment Program as described in this study is expected to reduce basewide energy consumption by approximately 6 percent per year through the end of FY 84 when the program will be completed. Upon completion of the ECIP, the energy consumption rate will undoubtedly begin to rise, but at a rate considerably below that of the past few years. While the move to more energy-efficient buildings, processes and equipment will retard growth in energy consumption, increased use of energy-consuming equipment will tend to accelerate the growth rate.

Although the energy consumption per square foot of building area has decreased by approximately 5 percent since 1975, the trend since

TOTAL BASEWIDE ENERGY CONSUMPTION

FIGURE 1



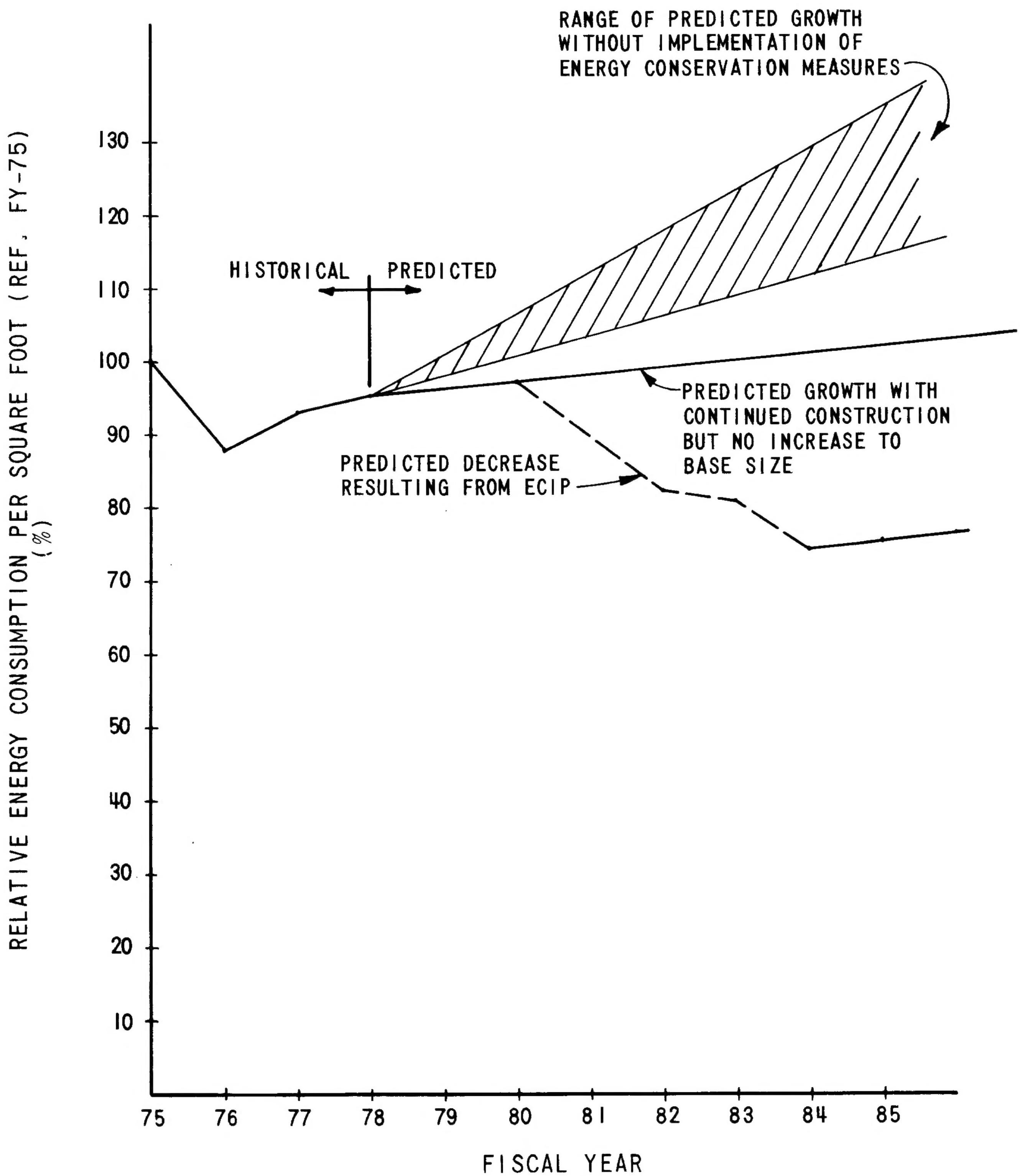
1976 has been to increase consumption about 1 percent per year. Normal growth rate will range from 3 to 6 percent per square foot per year, but the Army's ongoing program for energy conservation has moderated this rate. Figure 2 illustrates the unitized energy consumption. Continuing the current policies, without additional conservation efforts, would maintain energy consumption below the FY 75 quantities until 1983. The Energy Conservation Investment Program is expected to reduce the unitized energy consumption to 75 percent of the FY 75 consumption by FY 85. At the completion of the ECIP, consumption will again begin to rise, surpassing 1975 consumption by the year 2010.

It is obvious that long range predictions (beyond 5 years) of energy consumption are nebulous at best. Future conservation requirements and energy policies may result in acceptance of many conservation projects that are not economically attractive at this time. Many of the projects evaluated in this study may become desirable if energy costs escalate faster than these calculations assume.

Many energy conserving schemes were evaluated under criteria established for the Energy Conservation Investment Program. The results of the analyses resulted in five projects being programmed for FY 81 and FY 82, and seven projects being recommended for FY 83 and FY 84.

Several projects that were very promising when first evaluated failed to meet ECIP guidelines because of the implementation of building temperature restrictions. These projects, which are discussed later, should be considered when maintenance or replacement money is available.

UNITIZED ENERGY CONSUMPTION
MM BTU/SF
FIGURE 2



Additionally, several energy saving projects do not qualify for ECIP consideration since they were not "capital investment" projects but normal maintenance items. These projects, which are discussed later, should be accomplished in future maintenance programs.

## ENERGY CONSERVATION CONSIDERATIONS

Each energy conservation item considered is listed in Table 1 along with its evaluation criteria. To be selected for inclusion in an energy conservation project, each item was required to have a benefit to cost ratio greater than 1.0, an E/C ratio greater than 17, and a payback period less than the expected life of the facility. All evaluations were based on 1981 cost data for the initial rankings. Items meeting the ECIP criteria were grouped for minimum disruption and ranked for inclusion in a particular fiscal year program.

In order to evaluate compliance with the goals for energy conservation, the FM Control System and the Oxygen Control System for Boilers are considered energy management savings. Savings from new construction are estimated to be equal to the difference between the expected annual growth of 3 percent and the actual annual growth of 1 percent. The remainder of the recommended energy conservation items are considered as ECIP savings. Figure 3 shows the extent of compliance with the goals.

Fifty energy conservation items were evaluated under ECIP criteria. Twenty-four items were recommended. All 50 items, and the evaluation criteria for each, are listed in Table 2.

Projects that required no capital investment, but should be considered as part of the maintenance program, include reduction of fresh air intake and use of energy-efficient low impedance fluorescent light bulbs. Projects recommended when replacement is required would include high efficiency electrical appliances such as kitchen ranges and water heaters,

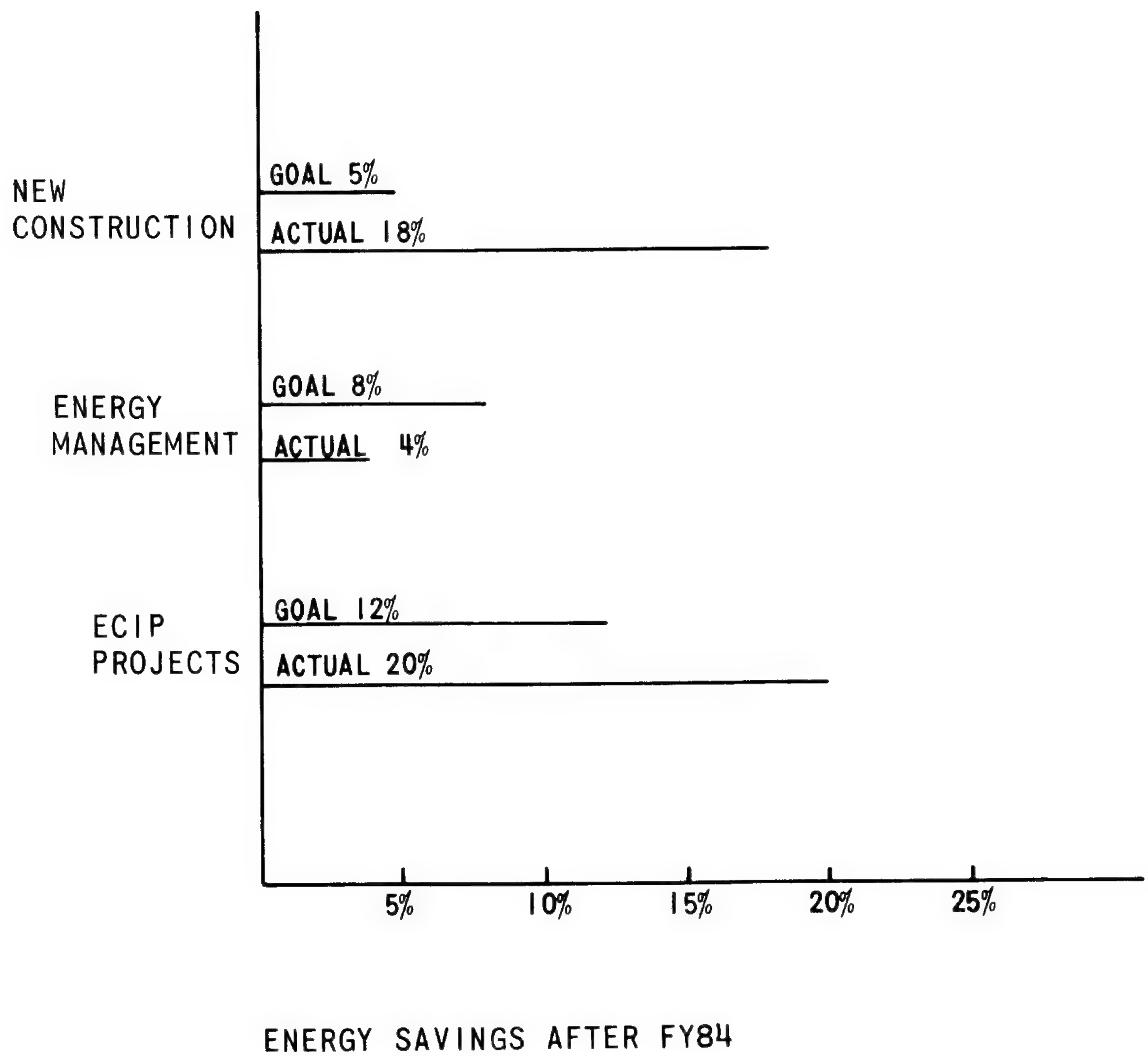

NEW
CONSTRUCTION
GOAL 5%
ACTUAL 18%
ENERGY
MANAGEMENT
GOAL 8%
ACTUAL 4%
ECIP
PROJECTS
GOAL 12%
ACTUAL 20%
5%
10%
15%
20%
25%
ENERGY SAVINGS AFTER FY84

FIGURE 3

installation of heat pumps with a "hot tap" heat recovery system for domestic water heating, exterior roof insulation in family housing with vaulted ceilings, and the replacement of electrical motors with high efficiency motors.

Conservation items meeting ECIP criteria were grouped into projects consisting of work to be done on a given type of building. This was done to minimize the length of disruption to building occupants. In some instances, it was necessary to separate types of modifications to a given building in order to maintain separation of contractors and to obtain lower costs to the Government. All family housing items, except the FM Control System, were grouped together and assigned to FY 84. Table 3 lists each recommended project, grouped according to fiscal year, and shows project cost and energy savings. All costs in Table 3 are based on FY 81.

Project numbers referenced in Table 3 are temporary numbers applied for the purposes of this report and will not be seen on the final programming documents.

TABLE 2

Summary of Energy Conservation Items

| Item | Benefit to Cost | E/C | Payback Period Years |
|---|---|---|---|
| FM Control System for Nonresidential Facilities | 4.11 | 99.00 | 3.00 |
| Permanent Barracks - Storm Windows & Solar Film | 1.41 | 32.81 | 12.6 |
| Permanent Barracks - Weatherstripping & Calking | 13.35 | 287.36 | 1.37 |
| Permanent Barracks - Flow Control Shower Heads | 38.56 | 293.29 | 1.52 |
| Permanent Buildings - Insulation Storm Windows & Solar Film | 5.11 | 110.35 | 3.57 |
| Temporary Buildings - Insulation, Storm Windows & Solar Film | 2.10 | 42.38 | 9.18 |
| Temporary Buildings - Weatherstripping & Calking | 7.21 | 155.14 | 2.53 |
| Load Balancing for Buildings | 0.90 | 18.0 | 19.0 |
| Low Voltage Transformers | | | |
| Motor Capacitors | 0.011 | 0.22 | 1,510 |
| Incandescent Light Replacement | | | |
| Offices | 2.55 | 21.1 | 5.18 |
| Warehouses | 1.50 | 18 | 11.1 |

TABLE 2

Summary of Energy Conservation Items
(Cont'd)

| Item | Benefit to Cost | E/C | Payback Period Years |
|---|---|---|---|
| Recreational Field Light Replacement | 2.51 | 32.2 | 5.4 |
| Solar | | | |
| Barracks Hot Water | 0.71 | 13.3 | 26.6 |
| Swimming Pool Heating | 1.4 | 25.3 | 13.6 |
| Solar Pond - Barrack DHW | 0.92 | 17.1 | 20.7 |
| Voltage Conversion | | | |
| Voltage Conversion of Existing Primary Conductor for Feeder No. 7 from 4.16 kV to 12.5 kV | 0.022 | 0.233 | 765.98 |
| Voltage Conversion of Existing Primary Conductor (477 MCM ACSR) for Feeder Nos. 7, 14, and 16 from 12.5 kV to 25.0 kV | 0.072 | 0.744 | 238 |
| Power Factor Improvement | | | |
| Reduction of Losses in Primary Distribution System by Power Factor Improvements | 0.88 | 8.76 | 20.58 |
| Reduction of Losses in Primary Distribution System by Power Factor Improvment (N.F.H.) | 0.17 | 0.63 | 100.48 |
| Street Light Replacement | | | |
| Street Lighting Replacement 450 wt Hg with 250 wt HPS | 0.46 | 14.01 | 45.28 |
| Street Lighting Replacement 450 wt Hg with 200 wt HPS | 0.66 | 17.09 | 29.2 |

TABLE 2

Summary of Energy Conservation Items
(Cont'd)

| Item | Benefit to Cost | E/C | Payback Period Years |
|---|---|---|---|
| Street Lighting Replacement 250 wt Hg with 150 wt HPS | 0.23 | 8.58 | 118.4 |
| Street Lighting Replacement 175 wt Hg with 100 wt HPS | 0.16 | 7.22 | 367.4 |
| Primary Conductor Replacement | | | |
| Replacement of Existing 2/0 AWG Copper Primary Conductor with 477 MCM ACSR Conductor on Distribution Feeder Ckt. No. 1 | 2.58 | 23.30 | 6.59 |
| Replacement of Existing 1/0 AWG Copper Primary Conductor with 477 MCM ACSR Conductor on Distribution Feeder No. 2 | 2.12 | 19.74 | 8.03 |
| Replacement of Existing 4/0 AWG Copper Primary Conductor with 477 MCM ACSR Conductor on Distribution Feeder Ckt. No. 1 | 2.07 | 17.32 | 8.17 |
| $O_2$ Controls for Large Boilers | 2.8 | 49.82 | 6.75 |
| Energy Recovery from Solid Waste | 0.74 | 22.47 | 86.90 |
| Nonbarracks Permanent Buildings under 10,000 sq. ft | | | |
| Ceiling Insulation, Storm Windows and Solar Film | 1.96 | 42.76 | 9.26 |
| Calking and Weatherstripping | 8.05 | 170.92 | 2.27 |

TABLE 2

Summary of Energy Conservation Items
(Cont'd)

| Item | Benefit to Cost | E/C | Payback Period Years |
|---|---|---|---|
| FM Control System | 5.07 | 104.92 | 2.32 |
| Weatherstrip & Calk | 2.60 | 83.03 | 4.67 |
| Flow Restrictive Shower Heads | 8.95 | 255 | 1.39 |
| Insulation for Vaulted Type Ceilings (Pershing Park) | 0.28 | 7.25 | 61.58 |
| Heat Pump | 0.63 | 16.65 | 24.18 |
| Hot Tap | 1.36 | 46.23 | 8.82 |
| Storm Windows | | | |
| Storm Windows Unair-conditioned Units | 1.02 | 29.59 | 12.20 |
| Storm Windows A/C Units | 2.38 | 78.12 | 5.1 |
| Storm Windows w/Solar Film A/C Units | 1.2 | 41.94 | 9.92 |
| Furnace Modifications | | | |
| Automatic Flue Dampers | 0.37 | 10.42 | 34.04 |
| Vent Restrictors | 0.87 | 24.86 | 14.26 |
| Furnace Derating | 0.60 | 17.20 | 20.62 |
| Replacing Kitchen Light Fixtures | 1.73 | 34.54 | 9.53 |
| Replacing Bathroom Light Fixtures | 0.68 | 19.9 | 24.2 |
| Dryer Peak Control | 3.06 | -- | 3.9 |

TABLE 2

Summary of Energy Conservation Items
(Cont'd)

| Item | Benefit to Cost | E/C | Payback Period Years |
|---|---|---|---|
| Solar | | | |
| Domestic Water Heating (per unit) | 0.51 | 9.5 | 37.4 |
| SPH/DHW System (per unit) | 0.52 | 9.7 | 36.5 |
| Air-conditioning (per unit) | 0.35 | 3.3 | 54 |
| Utility Meter Installation (per unit) | 0.36 | 20.5 | 78 |
| Energy Monitoring Control System | 0.75 | 33.4 | 19.3 |
| Modifications & Facilities for Use of Waste Oil as Boiler Fuel | 6.33 | 43.3 | 3.7 |

TABLE 3

Recommended ECIP Projects

| Project Number | Fiscal Year | Project Description | Construction Cost (FY 81) | Annual Energy Savings (MegaBtu) | E/C |
|---|---|---|---|---|---|
| T-881 | 81 | FM Control System for Nonresidential Facilities | $ 637,226 | 63,054 | 99.0 |
| T-883 | 81 | Permanent Buildings Insulation Storm Windows & Solar Film | 1,732,424 | 191,165 | 110.4 |
| T-886 | 81 | Family Housing FM Control System | 886,787 | 93,038 | 104.9 |
| TOTAL FY 81 | | | $3,256,437 | 347,257 | 106.6 |
| T-882 | 82 | Permanent Barracks - Storm Windows & Solar Film | 2,922,719 | 92,609 | 32.8 |
| T-882 | 82 | Permanent Barracks - Weatherstripping & Calking | 226,495 | 65,086 | 287.4 |
| T-882 | 82 | Permanent Barracks - Flow Control Shower Heads | 59,551 | 40,600 | 718.0 |

TABLE 3

Recommended ECIP Projects
(Cont'd)

| Project Number | Fiscal Year | Project Description | Construction Cost (FY 81) | Annual Energy Savings (MegaBtu) | E/C |
|---|---|---|---|---|---|
| T-885 | 82 | Temporary Buildings - Insulation, Storm Windows & Solar Film | $1,411,428 | 59,816 | 42.4 |
| T-885 | 82 | Temporary Buildings - Weatherstripping & Calking | 86,935 | 13,487 | 155.1 |
| TOTAL FY 82 | | | $4,707,128 | 271,598 | 57.7 |
| T-889 | 83 | Solar Swimming Pool Heating | 140,536 | 3,561 | 25.3 |
| T-894 | 83 | $O_2$ Controls for Large Boilers | 292,551 | 15,362 | 49.8 |
| | | Nonbarracks Permanent Buildings under 10,000 sq. ft. | | | |
| T-891 | 83 | Ceiling Insulation, Storm Windows and Solar Film | 431,378 | 18,446 | 42.8 |
| T-891 | 83 | Calking and Weather-stripping | 17,962 | 3,070 | 170.9 |

TABLE 3

Recommended ECIP Projects
(Cont'd)

| Project Number | Fiscal Year | Project Description | Construction Cost (FY 81) | Annual Energy Savings (MegaBtu) | E/C |
|---|---|---|---|---|---|
| T-893 | 83 | Modifications on Facilities for Use of Waste Oil as Boiler Fuel | $ 232,949 | 10,085 | 43.3 |
| T-887 | 83 | Incandescent Light Replacement | | | |
| | | Offices | 119,978 | 2,534 | 21.1 |
| | | Warehouses | 245,975 | 4,411 | 18 |
| TOTAL FY 83 | | | $1,481,329 | 57,469 | 38.8 |
| T-884 | 84 | Family Housing Weatherstrip & Calk | 1,041,916 | 86,514 | 83.0 |
| T-884 | 84 | Family Housing Flow Restrictive Shower Heads | 218,376 | 55,697 | 255.0 |
| T-884 | 84 | Unair-conditioned Family Housing Storm Windows | 283,292 | 8,384 | 29.6 |

TABLE 3

Recommended ECIP Projects
(Cont'd)

| Project Number | Fiscal Year | Project Description | Construction Cost (FY 81) | Annual Energy Savings (MegaBtu) | E/C |
|---|---|---|---|---|---|
| T-884 | 84 | Air-conditioned Family Housing Storm Windows | $2,048,796 | 160,054 | 78.1 |
| T-884 | 84 | Replacing Kitchen Light Fixtures | 156,023 | 5,389 | 34.5 |
| TOTAL FY 84 | | | $3,748,403 | 316,038 | 84.3 |

## ALTERNATE ENERGY SOURCES

The reduction of reliance on critical fuels and elimination of natural gas usage dictate the study of alternate energy sources. Solar energy has gained national recognition as a promising energy source. For some applications, solar energy is a reliable, cost-effective means of supplying energy. For other applications, it is not suitable. The principal applications of interest for solar energy on military bases are domestic hot water (DHW) systems, DHW/space heating, swimming pools, and air-conditioning.

Several variations of each of these applicatins were evaluated against ECIP guidelines. The addition of solar heating to the Abrams Field House swimming pool met ECIP criteria and is recommended for FY 83. The other applications did not meet ECIP criteria.

Another alternate energy source is solid waste fuels. Fort Hood is approaching a solid waste generation rate of 100 tons per day, at which point the establishment of resource recovery facilities for source separation and materials and/or energy recovery will be required.

The economics of a resource recovery system without a ready market for recovered energy is highly questionable. A steam generator must have a steady and reliable market for the steam it produces, with a reasonably short transmission distance. Such a condition does not exist at Fort Hood. Energy recovery from solid waste will not meet ECIP guidelines.

Waste engine lubricating oil has been considered for use as boiler fuel for many years. In the past, the cost of collecting, processing, and delivering waste oil has been greater than the cost of new fuel oil.

The Fort Hood Directorate of Industrial Operations estimates purchases of 300,000 gallons of No. 2 fuel oil yearly. If all buildings with oil-firing capacities were to actually use oil, the total Fort Hood requirement would be approximately 700,000 gallons of No. 2 fuel oil yearly.

Waste oil is available in amounts ranging from 250,000 to 375,000 gallons per year from tactical vehicles only. Collection of this resource is being partially accomplished now, and the current unrecovered portion, along with additional waste lubricating oil from other sources, could probably be collected without great exertion.

Use of waste oil as a supplement to purchased fuel oil is environmentally acceptable and meets ECIP criteria. This project is recommended for implementation in FY 83.

The remaining alternatives are solid fuels or synthetic gas derived from solids. Solid fuels may be fired directly in boilers designed for the particular fuel to be burned or in boilers converted to the proper configuration. Either method is technically feasible, but neither may be economically feasible. Boilers of less than 20,000,000 Btuh capacity are poor candidates for coal firing due to the high cost of the necessary coal handling facilities. There are no boilers larger than this at Fort Hood.

Synthetic gas may be produced from coal or biomass; either process requires an appreciable investment in plant and operating personnel. The calorific value of the gases produced will depend upon the process chosen. Biomass conversion does not merit indepth investigation since the available biomass consists of only human sewage and organic garbage. It is doubtful that sufficient quantities of gas could be produced from such a small input. Coal gasification may have some merit provided that the calorific value of the gas produced is sufficient to satisfy the requirements of the post.

As an alternative to synthetic gas or the conversion of small individual boilers to solid fuel firing, a new central steam generating plant and steam distribution system may be considered. Such a plant would consist of multiple stoker-fired boilers, capable of accepting coal, solid waste, refuse derived fuels, pelletized wood products, or a combination of fuels. If a central steam generating plant and distribution system is to be built, then a relatively small additional investment would result in a selective energy plant producing electricity as a byproduct.

## UTILITY SYSTEMS

The electrical distribution system at Fort Hood is in satisfactory condition with adequate capacity to meet the anticipated future load growth.

Due to the normal growth of the system over a period of time, some feeder segment conductors may not be adequately sized for the present loading. Situations may exist when the conductor is thermally adequate but may be causing excessive losses and voltage drop. Replacement of selected overhead conductor segments with larger conductors was evaluated on the basis of cost savings resulting from reduced demand (kW) and energy losses (kWh) for the Fort Hood distribution system network.

Secondary benefits such as increased load capacity, improved voltage regulation, and improved overall system reliability attributed to new construction were not assigned any monetary value for this evaluation.

The results indicate that the payback periods for conductor replacement projects are favorable based on the energy savings at existing loads. Energy savings will increase as the load increases, thus making the project more attractive.

Fort Hood is served by the Texas Power & Light Company (TP&L). The TP&L service contract does not have a power factor penalty clause at this time. Therefore, power factor improvement was evaluated only the basis of cost savings resulting from reduced demand (kW) and energy losses (kWh).

The overall size of the power factor improvement capacitors for the Fort Hood main cantonment area and North Fort Hood was based on improving

the estimated 87.0 percent average power factor to 95.0 percent during peak load conditions. This total kvar of capacitors was then assumed to be distributed over the complete system as standardized units of about 300 kvar each, and installed at load centers or near the end of the feeder lines.

The power factor improvement project for Fort Hood main cantonment area has a marginal payback period. Although 2,592 million Btu of energy could be saved per year, the economics preclude implementation of this energy conservation measure. The power factor improvement project for the North Fort Hood area does not qualify for implementation under the ECIP criteria.

Generally, the economic advantages of higher voltages are not adequate to justify massive conversion of the existing lower voltage facilities. In the case of Fort Hood, the existing feeder circuit loading is comparable to the normal design criteria with sufficient capacity for anticipated future load growth. Additionally, since the present loading of these feeders is very light, the resultant savings in demand and energy losses is minimal.

Voltage conversion of existing feeder circuits does not qualify for implementation based on energy savings. In addition, conversion of some of the feeder circuits to a voltage different from the remainder of the system would reduce the flexibility of the various feeders to be connected or switched during critical periods. Conversion would also increase the inventory of materials due to a multi-voltage system, and could reduce personnel safety.

Replacement of mercury vapor luminaires with high pressure sodium luminaires will result in energy savings. However, the high replacement cost of the luminaires precludes this project since the ECIP criteria of benefit-to-cost ratio, energy savings-to-cost ratio and payback are not met as shown in Table 2.

In summary, existing mercury vapor luminaires should be replaced with or modified for high-pressure sodium luminaires as replacement becomes necessary during the normal maintenance program. In cases where higher lighting levels are required or new installations are planned, high-pressure sodium luminaires should be considered.

ENERGY MONITORING AND CONTROL SYSTEM

Small buildings with simple environmental systems do not require the full capabilities of an Energy Monitoring and Control System in accordance with the Inter-agency Guide Specification. Energy and electrical demand savings are sufficient to justify a simple FM Radio Control System providing automatic on/off control and demand reduction. This system consists of a programmable controller, an FM radio transmitter and multiple receiver/switches. Each receiver/switch is tuned to accept a control signal on one specific frequency which is broadcast by the FM transmitter under control of the programmable controller. This system is utilized on temporary and permanent buildings with less than 40 tons of air-conditioning capacity, and on air-conditioned family housing units.

Larger, more complex buildings require control functions of more complexity than an FM system can supply. Hardwired Energy Monitoring and Control Systems can provide this control, as well as many other functions, but at a much higher cost. A completely new system, conform- to the Inter-agency Guide Specification, will not meet ECIP criteria. However, the energy savings possible with automated control are substantial and should not be ignored, nor should the associated savings due to more efficient maintenance functions, security control, and other operations which may be affected by the system capabilities.

A true basewide EMCS for Fort Hood requires approximately 50 miles of data transmission cable and would control approximately 200 buildings. Although the cost of connecting each building (including all sensors,

controllers and internal wiring) can be economically justified, the savings are not great enough to overcome the cost of the central equipment and data transmission system.

ECIP PROJECTS

T-881 - FM Control System for Nonresidential Facilities

This project will consist of installing an FM radio controller in a central building. FM radio control switches will be installed on 198 chillers and package units and air handlers on temporary buildings, and 129 of the same on permanent buildings' air-conditioning systems for demand control. Also, 724 radio switches will be installed in 267 temporary buildings on the heating units for nighttime and weekend setback of space temperature. Six-hour timers, to provide local override of radio switches, will be installed in 40 percent of the buildings with temperature setback.

T-882 - Energy Conservation Modifications to Permanent Barracks

This project will consist of installing operable storm windows, with solar film and half screens, over existing windows; weatherstripping all doors; calking foundations and other cracks; and installing flow control shower heads.

T-883 - Energy Conservation Modifications to Permanent Barracks

This project will consist of installing operable storm windows, with solar film and half screens, over existing windows in air-conditioned buildings occupied over 12 hours per day; insulating ceilings in buildings having an existing U-value greater than 0.10; weatherstripping doors; and calking foundations and other cracks.

T-884 - Energy Conservation Modifications to Family Housing

This project will consist of weatherstripping all doors; calking foundations and other cracks; installing flow control shower heads; installing operable storm windows, with half screens, over existing windows; and replacing selected incandescent fixtures with fluorescent lights in 5,236 family housing units.

T-885 - Energy Conservation Modifications to Temporary Buildings

This project will consist of adding floor insulation and sheathing to air-conditioned temporary buildings; adding insulation to the ceiling of air-conditioned temporary buildings that have a U-value greater than 0.10; weatherstripping doors; calking cracks; and installing operable storm windows, with solar film and half screens, over existing windows in air-conditioned temporary buildings.

T-886 - FM Control System for Family Housing

This project will consist of installing FM radio control switches on 4,904 residential central air-conditioner compressors for demand control and temperature shutoff. Central control equipment will be provided under Project No. T419.

T-887 - Energy Conservation Incandescent Lighting Replacement

This project will consist of replacing incandescent lighting in temporary administration buildings and temporary warehouse storage type buildings with fluorescent lighting. This project involves 153 buildings.

T-888 - Energy Conservation Recreational Field Lighting

This project will consist of replacing incandescent lighting at 16 recreational fields with high intensity discharge (HID) lighting.

T-889 - Solar Heated Swimming Pool, Abrams Field House

This project will consist of installing a solar heating system for the indoor swimming pool at Creighton W. Abrams Field House (Building 23001). The solar collectors will be roof-mounted fin-tube type.

T-890 - Energy Conservation Replacement of Primary Conductors

This project will consist of replacing existing copper 2/0 and 4/0 AWG primary conductors on distribution feeder Ckt. No. 1 and 1/0 AWG primary conductor on distribution feeder Ckt. No. 2 with new 477 MCM ACSR conductors.

T-891 - Energy Conservation Modifications to Permanent Buildings Under 10,000 S.F.

This project will consist of installing operable storm windows, with solar film and half screens, over existing windows in air-conditioned buildings occupied over 12 hours per day; insulating ceilings in buildings having an existing U-value greater than 0.10; weatherstripping doors; and calking foundations and other cracks. This project involves 78 buildings.

T-893 - Modifications and Facilities for Use of Waste Oil as Boiler Fuel

This project will consist of modifications to existing oil-fired boilers at Bldg. No. 39043 enabling the use of waste vehicle oil as a supplemental fuel, and the construction of a central POL facility for collecting and processing waste vehicle oil.

T-894 - Energy Conservation Automated Control System for Large Boilers

This project will consist of the installation of modern combustion control systems utilizing continuous monitoring and control of flue gas oxygen content in 19 large boilers at 13 buildings.

TOTAL ENERGY/SELECTIVE ENERGY

Total Energy or Selective Energy systems basically produce electricity and utilize heat rejected by the generating process to satisfy other needs. A Selective Energy plant supplies a portion of the electrical requirements while a Total Energy plant satisfies all electrical requirements. The systems utilize heat rejected in condensing steam for return to a boiler, or the heat contained in the exhaust gases and cooling water of an internal combustion engine. This waste heat can be reclaimed to some extent and used to satisfy the requirement for space heating, domestic water heating, and absorption cooling processes.

Several Selective and Total Energy concepts were considered. The concepts are impaired by the lack of an existing steam distribution system at Fort Hood. Based on ECIP guidelines, neither a Selective Energy nor a Total Energy system is considered acceptable. It is recommended that the conventional system be retained.

CORPS OF ENGINEERS


BUILDING MODIFICATIONS LEGEND

1. INSTALL OPERABLE STORM WINDOWS WITH SOLAR FILM AND HALF SCREENS. WEATHERSTRIP ALL DOORS AND CALK ALL OPENINGS. INSULATE CEILINGS.
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11. INSTALL HIGH INTENSITY DISCHARGE LIGHT LIGHTING.
12. REPLACE PRIMARY ELECTRICAL DISTRIBUTION CONDUCTORS.
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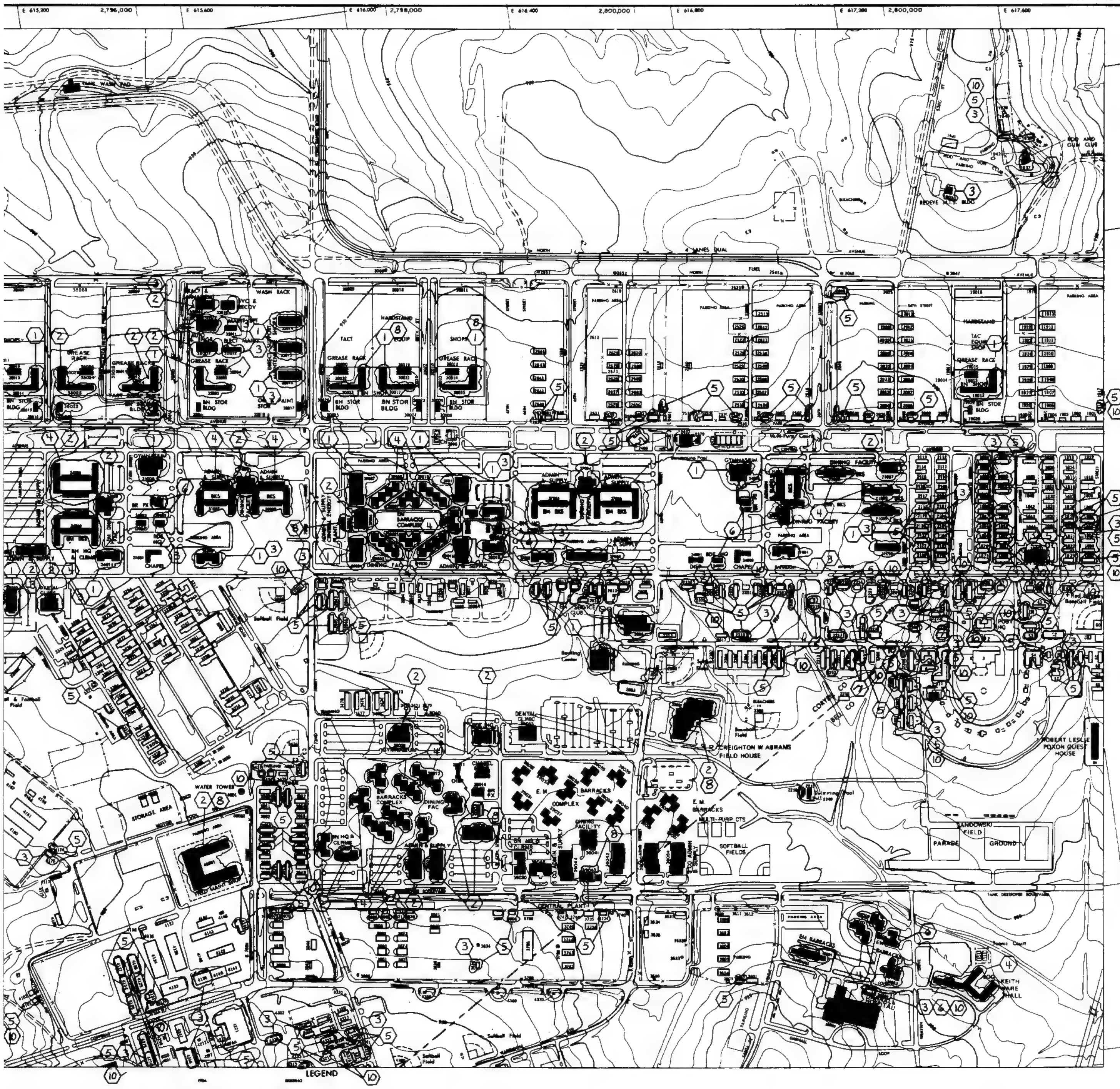
LEGEND

BUILDING, PERMANENT
BUILDING, SEMI-PERMANENT
BUILDING, TEMPORARY
ROADS AND PARKING
TRAIL, UNIMPROVED
FENCE, BARBED WIRE
FENCE, CHAIN LINK
FENCE AND BOUNDARY
RAILROAD
DRAINAGE CHANNEL
BRIDGE
CULVERT
RESERVATION BOUNDARY
INDEX CONTOUR
INTERMEDIATE CONTOUR
DEPRESSION CONTOUR
NOISE CONTOUR
AIRSPACE CORRIDORS

(1)




LEGEND

- BUILDING, PERMANENT
- BUILDING, SEMI-PERMANENT
- BUILDING, TEMPORARY
- ROADS AND PARKING
- TRAIL, UNIMPROVED
- FENCE, BARBED WIRE
- FENCE, CHAIN LINK
- FENCE AND BOUNDARY
- RAILROAD
- DRAINAGE CHANNEL
- BRIDGE
- CULVERT
- RESERVATION BOUNDARY
- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- DEPRESSION CONTOUR
- NOISE CONTOUR
- AIRSPACE CORRIDORS

KEY MAP

SCALE IN FEET AND METERS

# FORT HOOD

KILLEEN, TEXAS

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

MASTER PLAN
BASIC INFORMATION MAPS

## GENERAL ENERGY CONSERVATION MAP

RECOMMENDED BY THE INSTALLATION PLANNING BOARD FOR APPROVAL

DATE

REVIEWED & COMMENTED ON BY MAJOR COMMANDER & FORWARDED TO THE CHIEF OF ENGINEERS

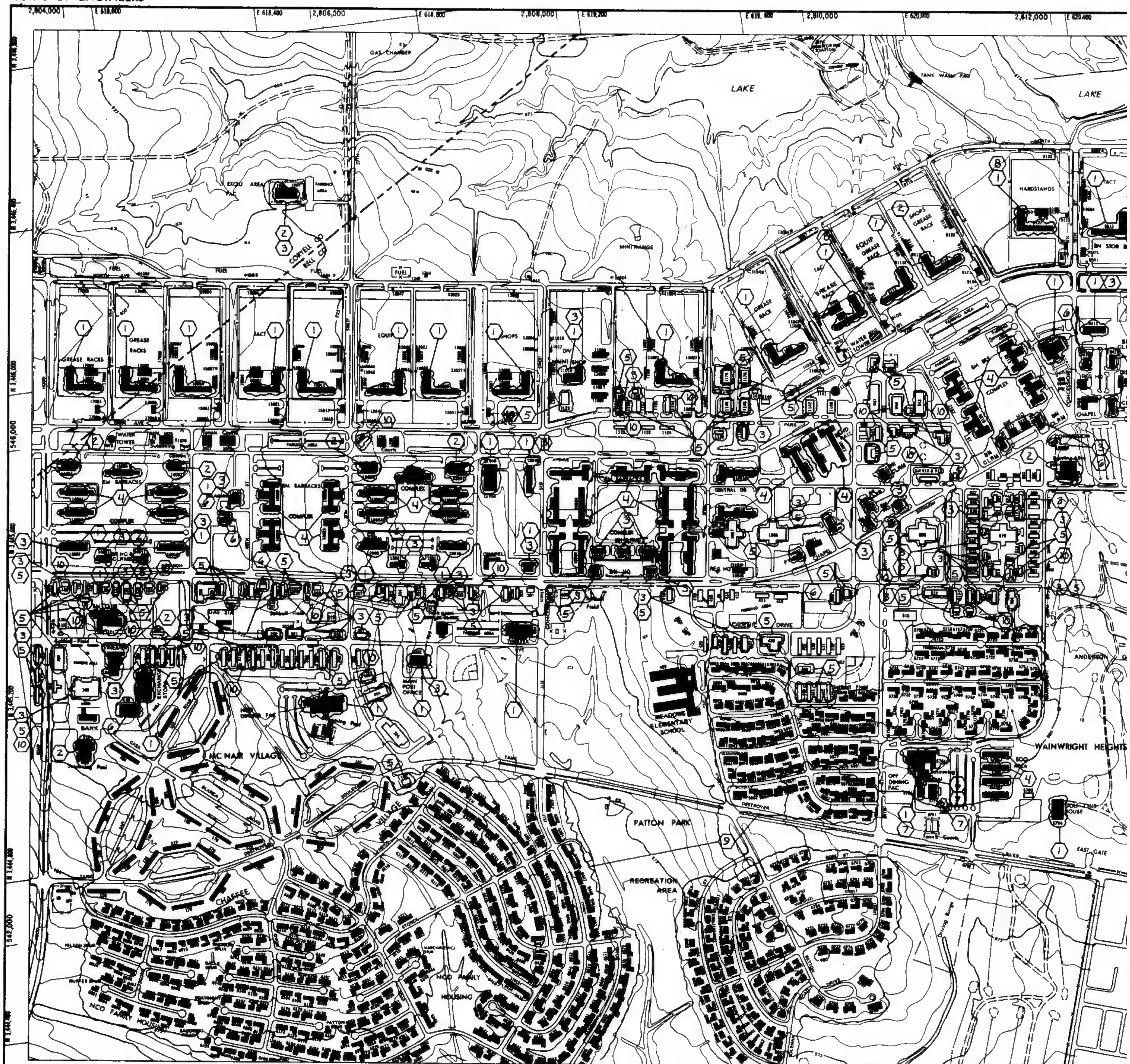
DATE

| DATE | DRAWING NO. |
|---|---|
| DEC. 1979 | |
| SHEET NO. 1 OF 12 | FILE NO. |



2

CORPS OF ENGINEERS

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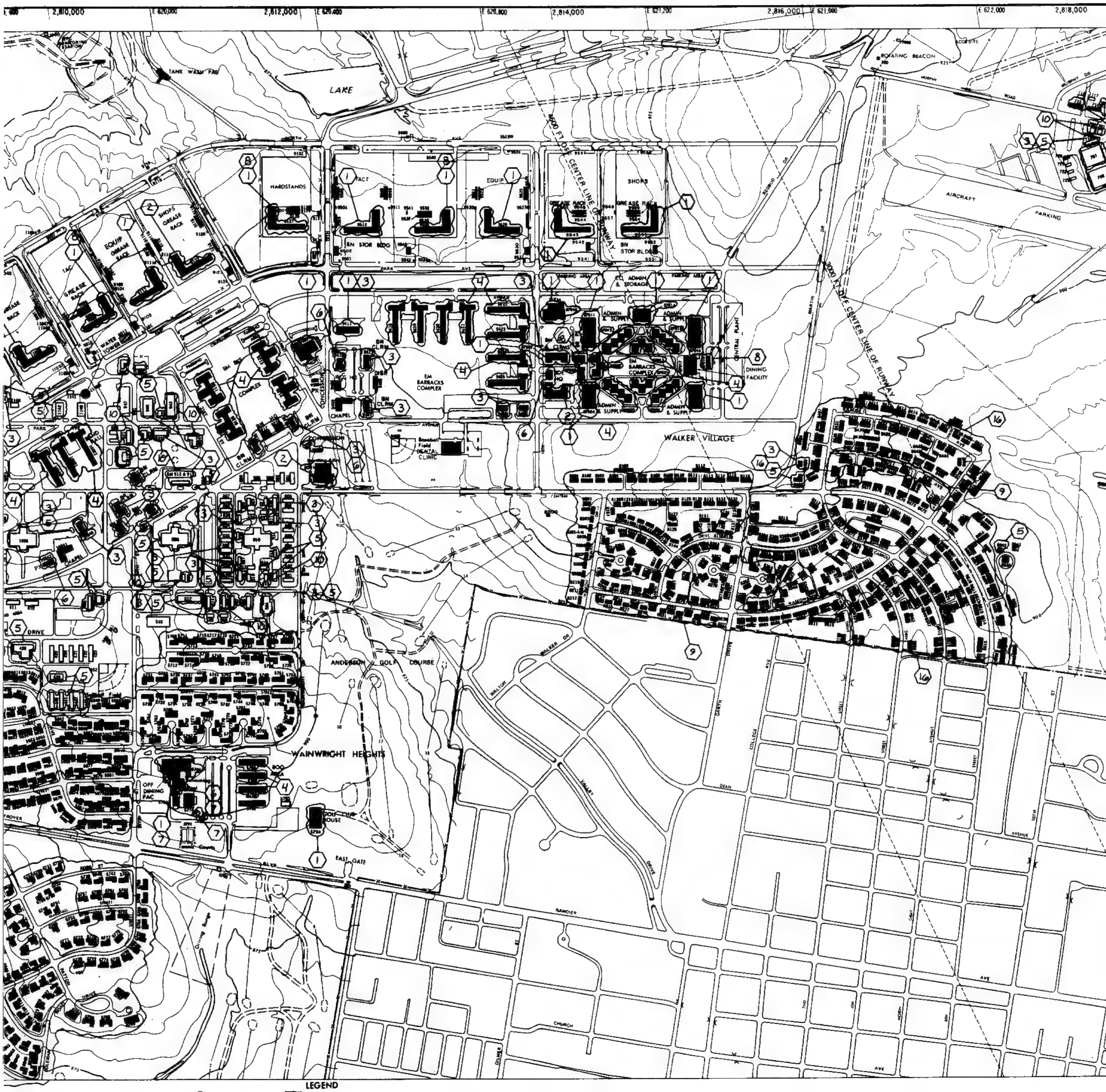
LEGEND

BUILDING, PERMANENT
BUILDING, SEMI-PERMANENT
BUILDING, TEMPORARY
ROADS AND PARKING
TRAIL, UNIMPROVED
FENCE, BARBED WIRE
FENCE, CHAIN LINK
FENCE AND BOUNDARY
RAILROAD
DRAINAGE CHANNEL
BRIDGE
CULVERT
RESERVATION BOUNDARY
INDEX CONTOUR
INTERMEDIATE CONTOUR
DEPRESSION CONTOUR
NOISE CONTOUR
AIRSPACE CORRIDORS

1




LEGEND

BUILDING, PERMANENT
BUILDING, SEMI-PERMANENT
BUILDING, TEMPORARY
ROADS AND PARKING
TRAIL, UNIMPROVED
FENCE, BARBED WIRE
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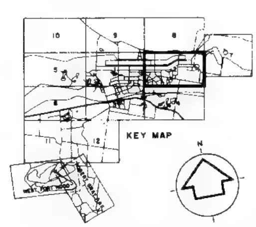
FENCE AND BOUNDARY
RAILROAD
DRAINAGE CHANNEL
BRIDGE
CULVERT
RESERVATION BOUNDARY
INDEX CONTOUR
INTERMEDIATE CONTOUR
DEPRESSION CONTOUR
NOISE CONTOUR
AIRSPACE CORRIDORS




SCALE IN FEET AND METERS

# FORT HOOD
KILLEEN, TEXAS

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

MASTER PLAN
BASIC INFORMATION MAPS
## GENERAL ENERGY CONSERVATION MAP

RECOMMENDED BY THE INSTALLATION PLANNING BOARD FOR APPROVAL

DATE

REVIEWED & COMMENTED ON BY MAJOR COMMANDER & FORWARDED TO THE CHIEF OF ENGINEERS

DATE

| DATE | DRAWING NO |
|---|---|
| DEC. 1979 | |
| SHEET NO 2 OF 12 | FILE NO. |



2

CORPS OF ENGINEERS


**BUILDING MODIFICATIONS LEGEND**

1. INSTALL OPERABLE STORM WINDOWS WITH SOLAR FILM AND HALF SCREENS. WEATHERSTRIP ALL DOORS AND CALK ALL OPENINGS. INSULATE CEILINGS.
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**LEGEND**

- BUILDING, PERMANENT
- BUILDING, SEMI-PERMANENT
- BUILDING, TEMPORARY
- ROADS AND PARKING
- TRAIL, UNIMPROVED
- FENCE, BARBED WIRE
- FENCE, CHAIN LINK
- FENCE AND BOUNDARY
- RAILROAD
- DRAINAGE CHANNEL
- BRIDGE
- CULVERT
- RESERVATION BOUNDARY
- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- DEPRESSION CONTOUR
- NOISE CONTOUR
- AIRSPACE CORRIDORS

(1)


## LEGEND

- BUILDING, PERMANENT
- BUILDING, SEMI-PERMANENT
- BUILDING, TEMPORARY
- ROADS AND PARKING
- TRAIL, UNIMPROVED
- FENCE, BARBED WIRE
- FENCE, CHAIN LINK
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- BRIDGE
- CULVERT
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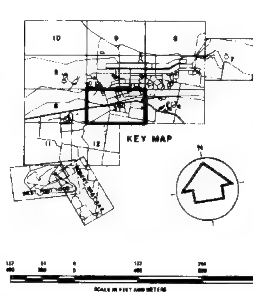
- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- DEPRESSION CONTOUR
- NOISE CONTOUR
- AIRSPACE CORRIDORS




SCALE IN FEET AND METERS

# FORT HOOD

KILLEEN, TEXAS

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

MASTER PLAN
BASIC INFORMATION MAPS

## GENERAL ENERGY CONSERVATION MAP

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DATE

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DATE

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|---|---|
| DEC. 1979 | |
| SHEET NO 3 OF 12 | FILE NO. |



2

CORPS OF ENGINEERS


**BUILDING MODIFICATIONS LEGEND**

(1) INSTALL OPERABLE STORM WINDOWS WITH SOLAR FILM AND HALF SCREENS. WEATHERSTRIP ALL DOORS AND CALK ALL OPENINGS. INSULATE CEILINGS.

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(11) INSTALL HIGH INTENSITY DISCHARGE LIGHT LIGHTING.

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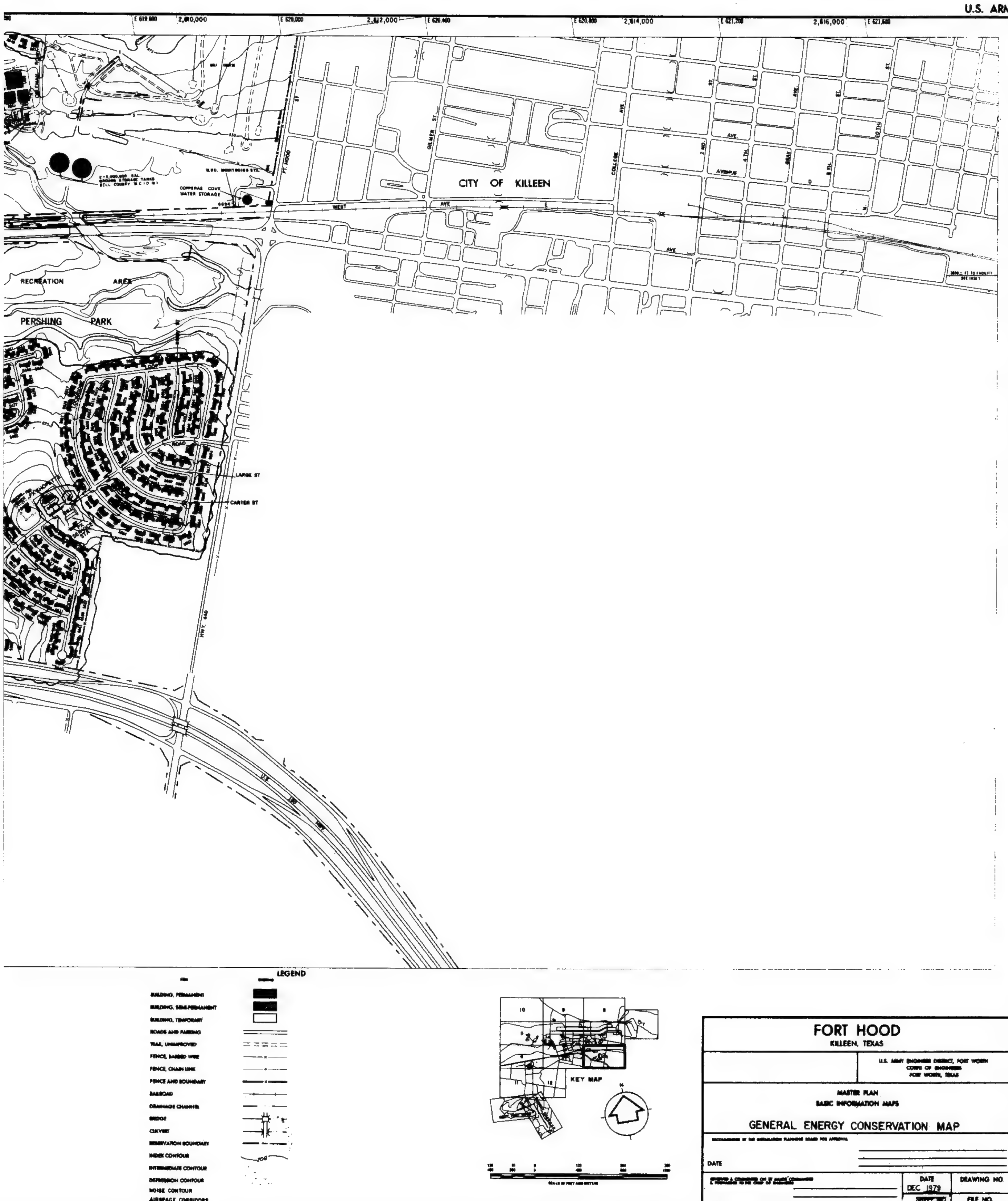
**LEGEND**

BUILDING, PERMANENT
BUILDING, SEMI-PERMANENT
BUILDING, TEMPORARY
ROADS AND PARKING
TRAIL, UNIMPROVED
FENCE, BARBED WIRE
FENCE, CHAIN LINK
FENCE AND BOUNDARY
RAILROAD
DRAINAGE CHANNEL
BRIDGE
CULVERT
RESERVATION BOUNDARY
INDEX CONTOUR
INTERMEDIATE CONTOUR
DEPRESSION CONTOUR
NOISE CONTOUR
AIRSPACE CORRIDORS

(1)

U.S. ARMY

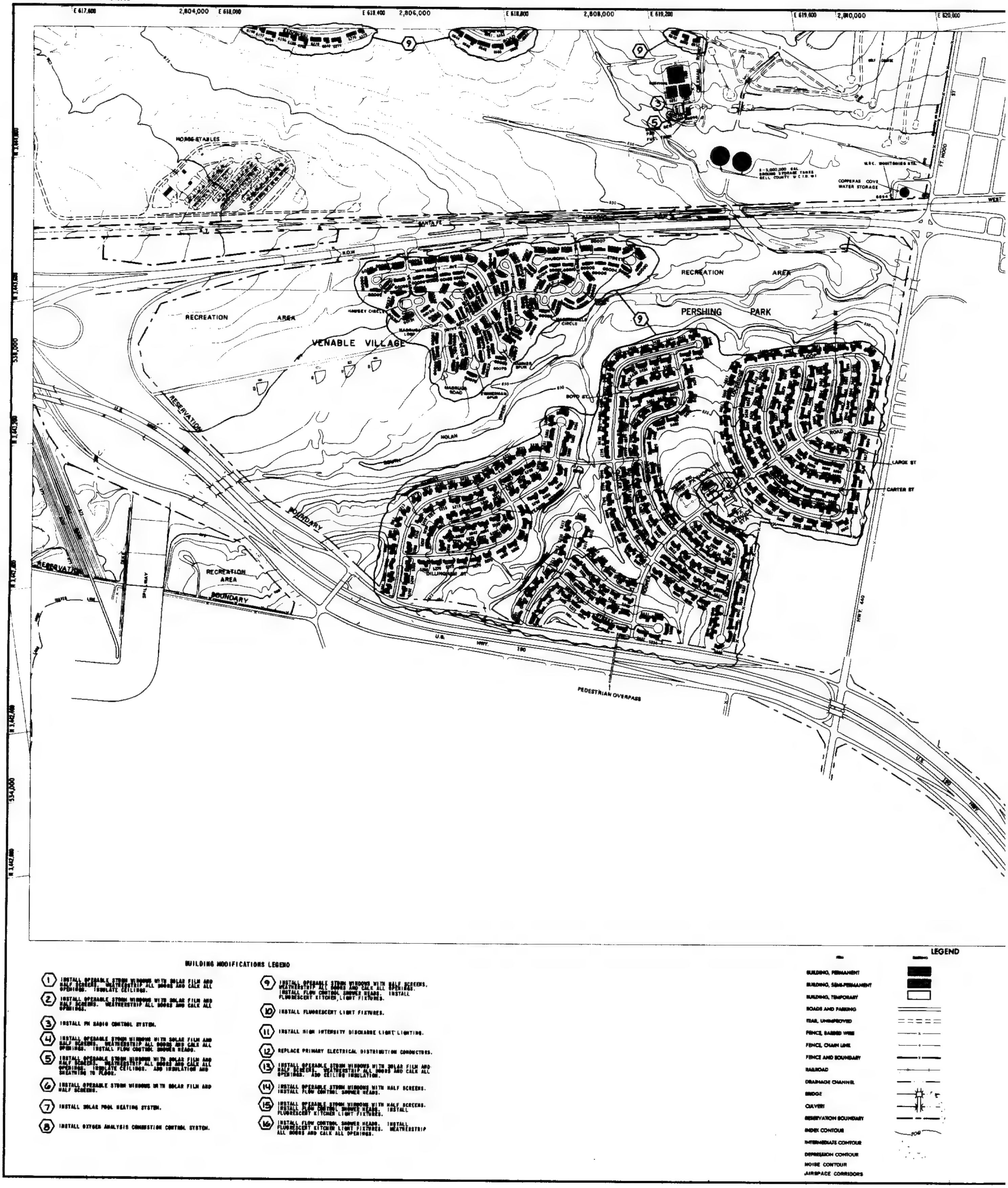



| | | |
|---|---|---|
| **FORT HOOD**<br>KILLEEN, TEXAS | | |
| | U.S. ARMY ENGINEER DISTRICT, FORT WORTH<br>CORPS OF ENGINEERS<br>FORT WORTH, TEXAS | |
| MASTER PLAN<br>BASIC INFORMATION MAPS<br>GENERAL ENERGY CONSERVATION MAP | | |
| DATE | | |
| DATE | DATE<br>DEC 1979 | DRAWING NO. |
| | SHEET NO<br>4 OF 12 | FILE NO. |



(2)

CORPS OF ENGINEERS

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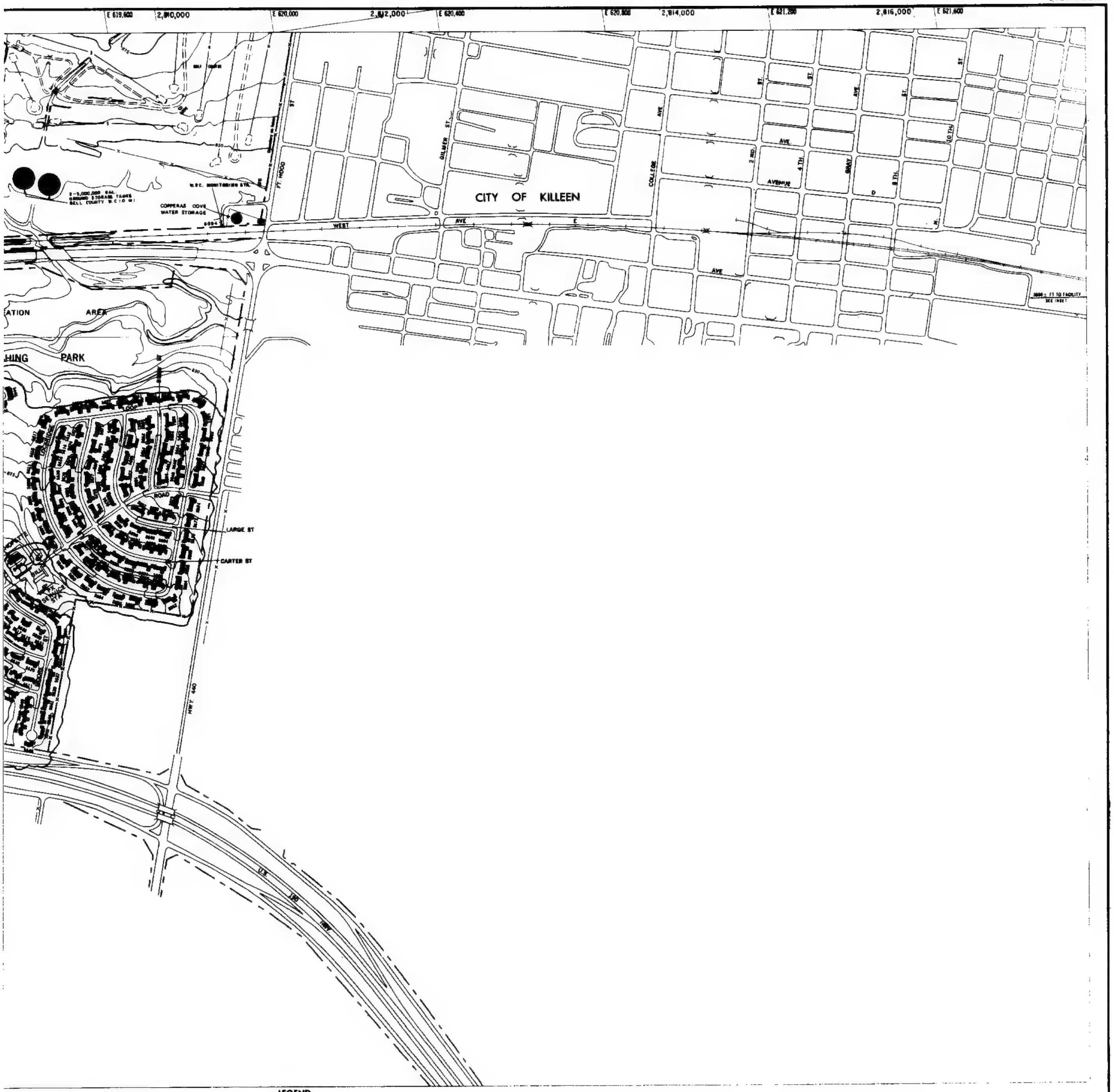
U.S. ARMY




LEGEND

BUILDING, PERMANENT
BUILDING, SEMI-PERMANENT
BUILDING, TEMPORARY
ROADS AND PARKING
TRAIL, UNIMPROVED
FENCE, BARBED WIRE
FENCE, CHAIN LINK
FENCE AND BOUNDARY
RAILROAD
DRAINAGE CHANNEL
BRIDGE
CULVERT
RESERVATION BOUNDARY
INDEX CONTOUR
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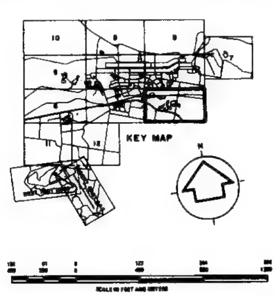
AIRSPACE CORRIDORS




# FORT HOOD

KILLEEN, TEXAS

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

MASTER PLAN
BASIC INFORMATION MAPS

## GENERAL ENERGY CONSERVATION MAP

RECOMMENDED BY THE INSTALLATION PLANNING BOARD FOR APPROVAL

DATE

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DATE

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|---|---|
| DEC 1979 | |
| SHEET NO 4 OF 12 | FILE NO. |



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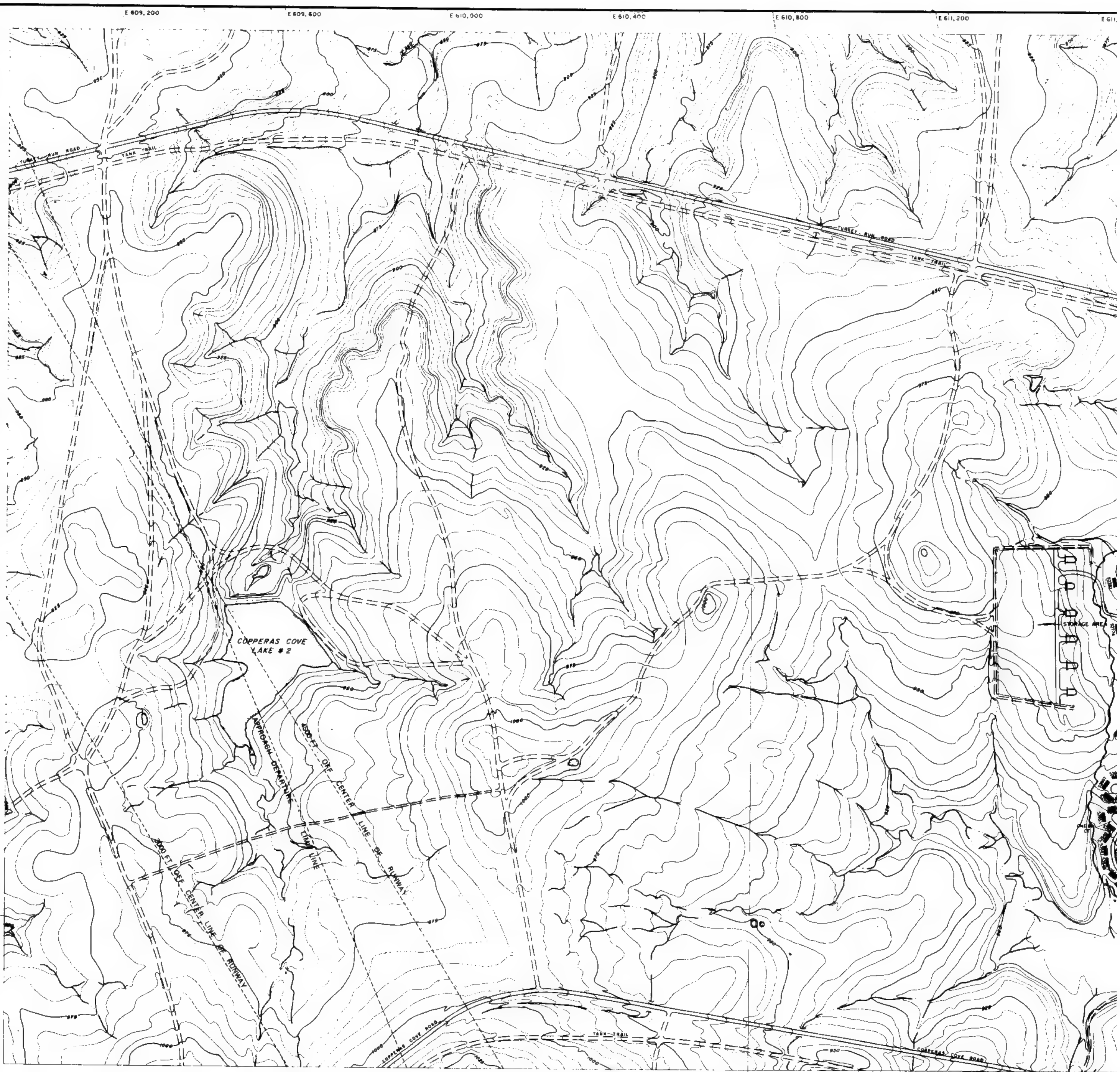
CORPS OF ENGINEERS




## BUILDING MODIFICATIONS LEGEND

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## LEGEND

| ITEM | EXISTING |
| --- | --- |
| BUILDING, PERMANENT | |
| BUILDING, SEMI-PERMANENT | |
| BUILDING, TEMPORARY | |
| ROADS AND PARKING | |
| TRAIL, UNIMPROVED | |
| FENCE, BARBED WIRE | |
| FENCE, CHAIN LINK | |
| FENCE AND BOUNDARY | |
| RAILROAD | |
| DRAINAGE CHANNEL | |
| BRIDGE | |
| CULVERT | |
| RESERVATION BOUNDARY | |
| INDEX CONTOUR | |
| INTERMEDIATE CONTOUR | |
| DEPRESSION CONTOUR | |
| NOISE CONTOUR | |
| AIRSPACE CORRIDORS | |

(1)

U.S. ARMY


LEGEND

| ITEM | EXISTING |
|---|---|
| BUILDING, PERMANENT | |
| BUILDING, SEMI-PERMANENT | |
| BUILDING, TEMPORARY | |
| ROADS AND PARKING | |
| TRAIL, UNIMPROVED | |
| FENCE, BARBED WIRE | |
| FENCE, CHAIN LINK | |
| FENCE AND BOUNDARY | |
| RAILROAD | |
| DRAINAGE CHANNEL | |
| BRIDGE | |
| CULVERT | |
| RESERVATION BOUNDARY | |
| INDEX CONTOUR | |
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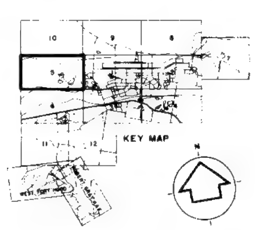
| DEPRESSION CONTOUR | |
| NOISE CONTOUR | |
| AIRSPACE CORRIDORS | |




SCALE IN FEET AND METERS

# FORT HOOD

KILLEEN, TEXAS

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

MASTER PLAN
BASIC INFORMATION MAPS

## GENERAL ENERGY CONSERVATION MAP

RECOMMENDED BY THE INSTALLATION PLANNING BOARD FOR APPROVAL

DATE

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DATE

| DATE DEC 1979 | DRAWING NO |
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| SHEET NO 5 OF 12 | FILE NO. |



2

CORPS OF ENGINEERS


BUILDING MODIFICATIONS LEGEND

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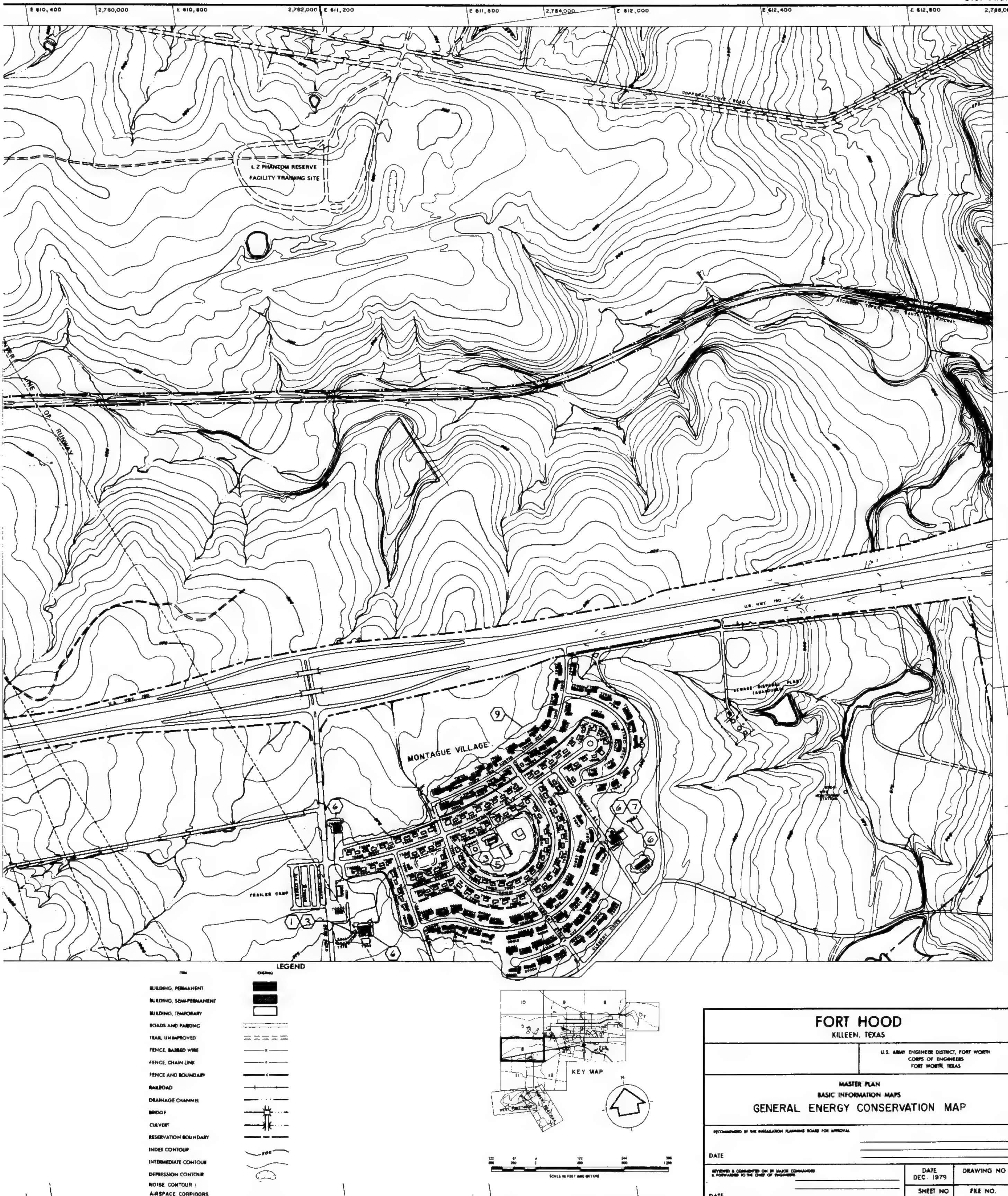
LEGEND

ITEM — EXISTING

- BUILDING, PERMANENT
- BUILDING, SEMI-PERMANENT
- BUILDING, TEMPORARY
- ROADS AND PARKING
- TRAIL, UNIMPROVED
- FENCE, BARBED WIRE
- FENCE, CHAIN LINK
- FENCE AND BOUNDARY
- RAILROAD
- DRAINAGE CHANNEL
- BRIDGE
- CULVERT
- RESERVATION BOUNDARY
- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- DEPRESSION CONTOUR
- NOISE CONTOUR \ AIRSPACE CORRIDORS

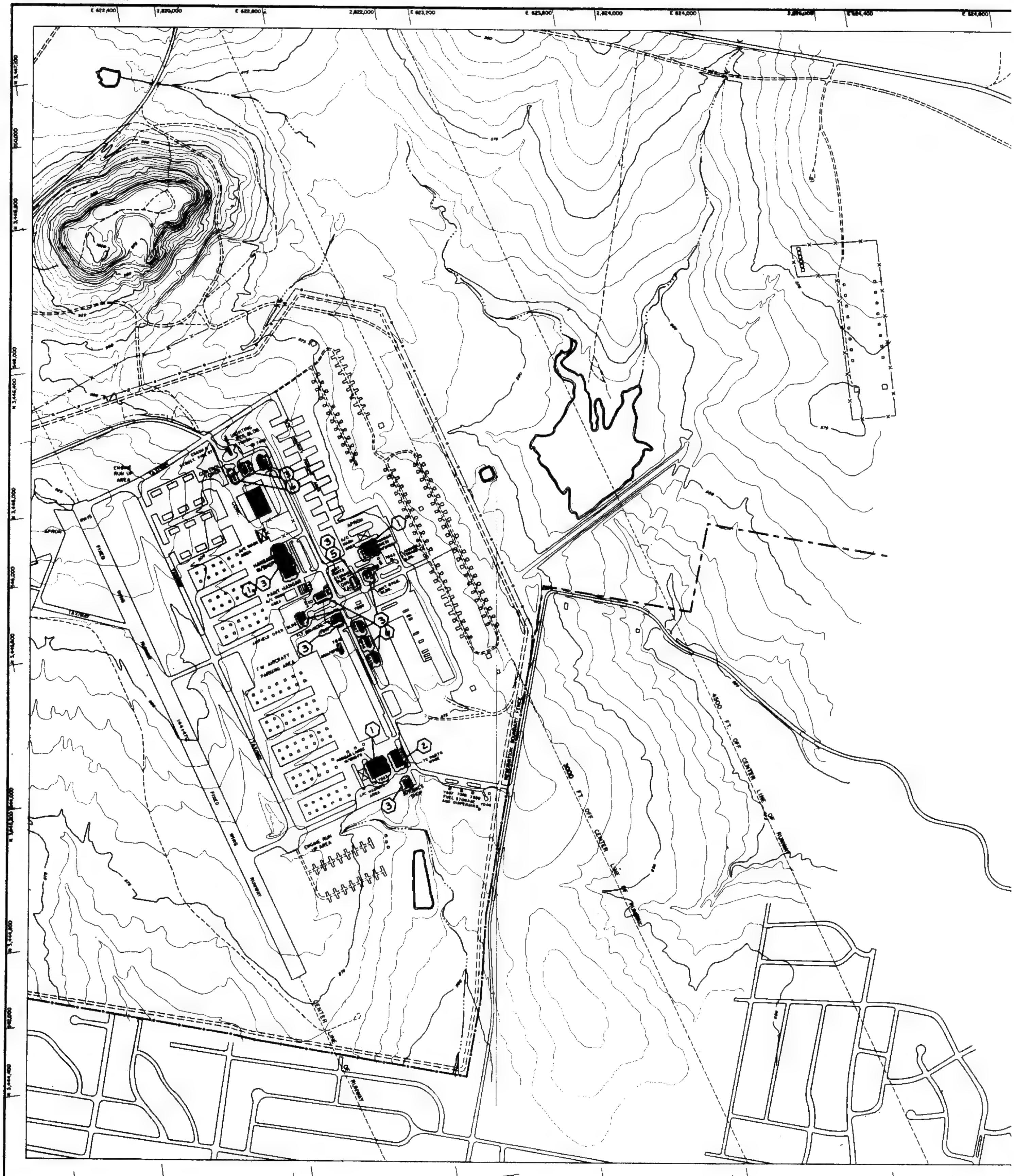
1


E 610,400
2,780,000
E 610,800
2,782,000
E 611,200
E 611,600
2,784,000
E 612,000
E 612,400
E 612,800
2,788,000
L Z PHANTOM RESERVE
FACILITY TRAINING SITE
COPPERAS COVE ROAD
ATCHISON TOPEKA AND SANTA FE RAILWAY
LINE OF RUNWAY
U.S. HWY. 190
SEWAGE DISPOSAL PLANT (ABANDONED)
MONTAGUE VILLAGE
TRAILER CAMP
9
6
7
1
3
5
LEGEND
BUILDING, PERMANENT
BUILDING, SEMI-PERMANENT
BUILDING, TEMPORARY
ROADS AND PARKING
TRAIL, UNIMPROVED
FENCE, BARBED WIRE
FENCE, CHAIN LINK
FENCE AND BOUNDARY
RAILROAD
DRAINAGE CHANNEL
BRIDGE
CULVERT
RESERVATION BOUNDARY
INDEX CONTOUR
INTERMEDIATE CONTOUR
DEPRESSION CONTOUR
NOISE CONTOUR \
AIRSPACE CORRIDORS
KEY MAP
N
FORT HOOD
KILLEEN, TEXAS
U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS
MASTER PLAN
BASIC INFORMATION MAPS
GENERAL ENERGY CONSERVATION MAP
RECOMMENDED BY THE INSTALLATION PLANNING BOARD FOR APPROVAL
DATE
REVIEWED & COMMENTED ON BY MAJOR COMMANDER & FORWARDED TO THE CHIEF OF ENGINEERS
DATE
DATE
DEC. 1979
DRAWING NO
SHEET NO
6 OF 12
FILE NO.



2

CORPS OF ENGINEERS

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U.S. ARMY

LEGEND

BUILDING, PERMANENT
BUILDING, SEMI-PERMANENT
BUILDING, TEMPORARY
ROADS AND PARKING
TRAIL, UNIMPROVED
FENCE, BARBED WIRE
FENCE, CHAIN LINK
FENCE AND BOUNDARY
RAILROAD
DRAINAGE CHANNEL
BRIDGE
CULVERT
RESERVATION BOUNDARY
INDEX CONTOUR
INTERMEDIATE CONTOUR
DEPRESSION CONTOUR
NOISE CONTOUR
AIRSPACE CORRIDORS

BUILDING MODIFICATIONS LEGEND

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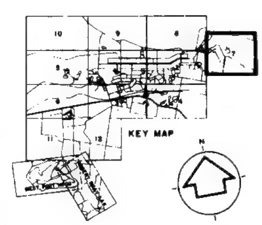



SCALE IN FEET AND METERS

# FORT HOOD
KILLEEN, TEXAS

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

MASTER PLAN
BASIC INFORMATION MAPS

## GENERAL ENERGY CONSERVATION MAP

RECOMMENDED BY THE INSTALLATION PLANNING BOARD FOR APPROVAL

DATE

REVIEWED & COMMENTED ON BY MAJOR COMMANDER & FORWARDED TO THE CHIEF OF ENGINEERS

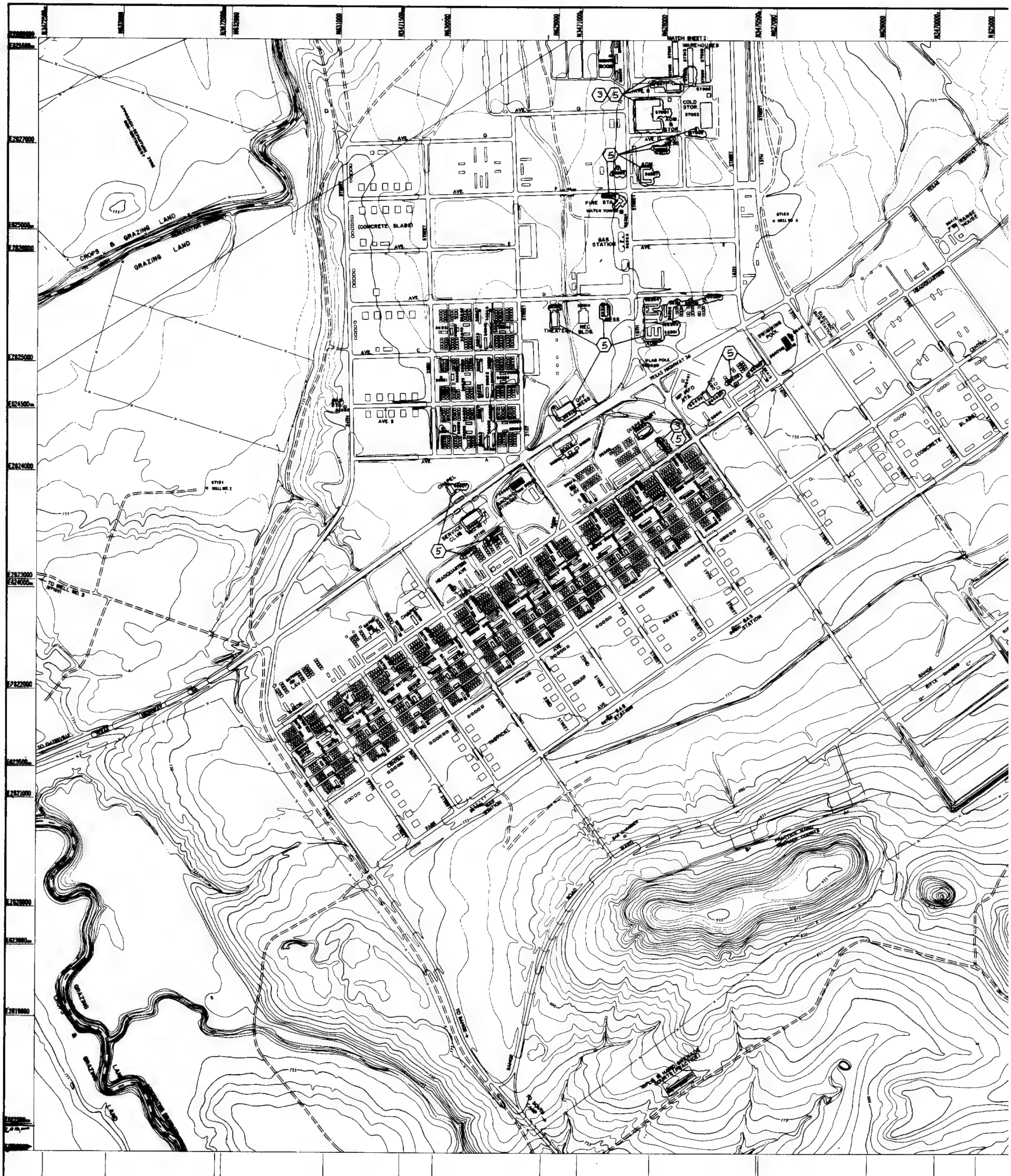
DATE

| DATE | DRAWING NO. |
|---|---|
| DEC 1979 | |
| SHEET NO 7 OF 12 | FILE NO. |

42

2

CORPS OF ENGINEERS

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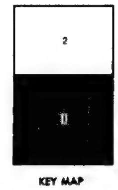


## LEGEND

| ITEM | EXISTING |
|---|---|
| BUILDING, PERMANENT | |
| BUILDING, SEMI-PERMANENT | |
| BUILDING, TEMPORARY | |
| TROOP TENT SLABS | |
| PAVEMENTS (roads, parking, airfields, etc.) | |
| TRAIL OR EARTH ROAD | |
| FENCE, BARBED WIRE | |
| FENCE, CHAIN LINK | |
| RESERVATION BOUNDARY | |
| RESERVATION BOUNDARY | |
| RESERVATION BOUNDARY | |
| RAILROAD | |
| BRIDGE | |
| CULVERT | |
| OUTLINE OF AREA LIMITS | |
| DAM | |
| SHORELINES | WATER / LAND |
| DRAINAGE CHANNEL | |
| MARSH AREAS | |
| INDEX CONTOUR | 750 |
| INTERMEDIATE CONTOUR | |
| DEPRESSION CONTOUR | |

### BUILDING MODIFICATIONS LEGEND

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SCALE IN FEET
UNIVERSAL TRANSVERSE MERCATOR GRID SYSTEM
CONTOUR INTERVAL 5 FEET
500 METER GRID

# FORT HOOD

KILLEEN, TEXAS

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

MASTER PLAN
BASIC INFORMATION MAPS

## GENERAL ENERGY CONSERVATION MAP

RECOMMENDED BY THE INSTALLATION PLANNING BOARD FOR APPROVAL

DATE

DATE

| DATE | DRAWING NO. |
|---|---|
| DEC. 1979 | 12-32-01 |
| SHEET NO. | FILE NO. |
| 1 of 2 | M-100-1 |



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CORPS OF ENGINEERS


(1)


KEY MAP

## LEGEND

| ITEM | EXISTING |
|---|---|
| BUILDING, PERMANENT | |
| BUILDING, SEMI-PERMANENT | |
| BUILDING, TEMPORARY | |
| TROOP TENT SLABS | |
| PAVEMENTS (roads, parking, airfields, etc.) | |
| TRAIL OR EARTH ROAD | |
| FENCE, BARBED WIRE | |
| FENCE, CHAIN LINK | |
| RESERVATION BOUNDARY | |
| RESERVATION BOUNDARY (FENCED-BARBED WIRE) | |
| RESERVATION BOUNDARY (FENCED-CHAIN LINK) | |
| RAILROAD | |
| BRIDGE | |
| CULVERT | |
| OUTLINE OF AREA LIMITS | |
| DAM | |
| SHORELINES | |
| DRAINAGE CHANNEL | |
| MARSH AREAS | |
| INDEX CONTOUR | |
| INTERMEDIATE CONTOUR | |
| DEPRESSION CONTOUR | |

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SCALE IN FEET
UNIVERSAL TRANSVERSE MERCATOR GRID SYSTEM
CONTOUR INTERVAL 5 FEET
500 METER GRID

# FORT HOOD

KILLEEN, TEXAS

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

MASTER PLAN
BASIC INFORMATION MAPS

## GENERAL ENERGY CONSERVATION MAP

RECOMMENDED BY THE INSTALLATION PLANNING BOARD FOR APPROVAL

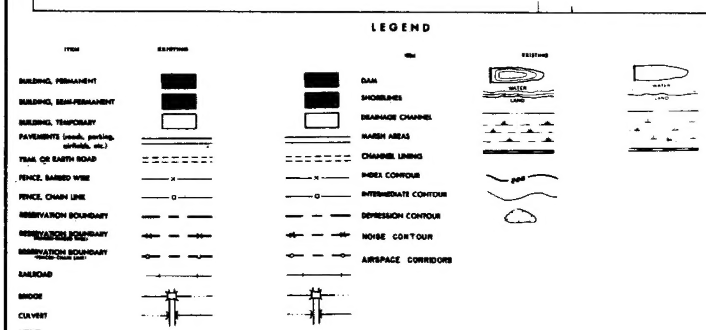
DATE

REVIEWED & CONCURRED IN BY MAJOR COMMANDER & FORWARDED TO THE CHIEF OF ENGINEERS

DATE

| DATE | DRAWING NO. |
|---|---|
| DEC. 1979 | 18-02-01 |
| SHEET NO. | FILE NO. |
| 2 of 2 | M-100-2 |

CORPS OF ENGINEERS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BUILDING MODIFICATIONS LEGEND

SOLAR FILM AND
RS AND CALK ALL

SOLAR FILM AND
RS AND CALK ALL

SOLAR FILM AND
RS AND CALK ALL
WER HEADS.

SOLAR FILM AND
RS AND CALK ALL
INSULATION AND

SOLAR FILM AND

CONTROL SYSTEM.

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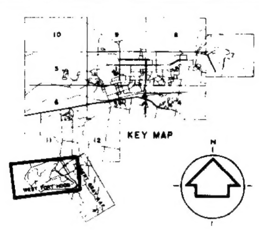


KEY MAP

N

SCALE IN FEET AND METERS

CONTOUR INTERVAL 5'

GRID: 1000m UTM GRID, CENTRAL ZONE
2000 FOOT TEXAS PLANE COORDINATE SYSTEM

# FORT HOOD

KILLEEN, TEXAS

U. S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS 76102

MASTER PLAN
BASIC INFORMATION MAPS

## GENERAL ENERGY CONSERVATION MAP

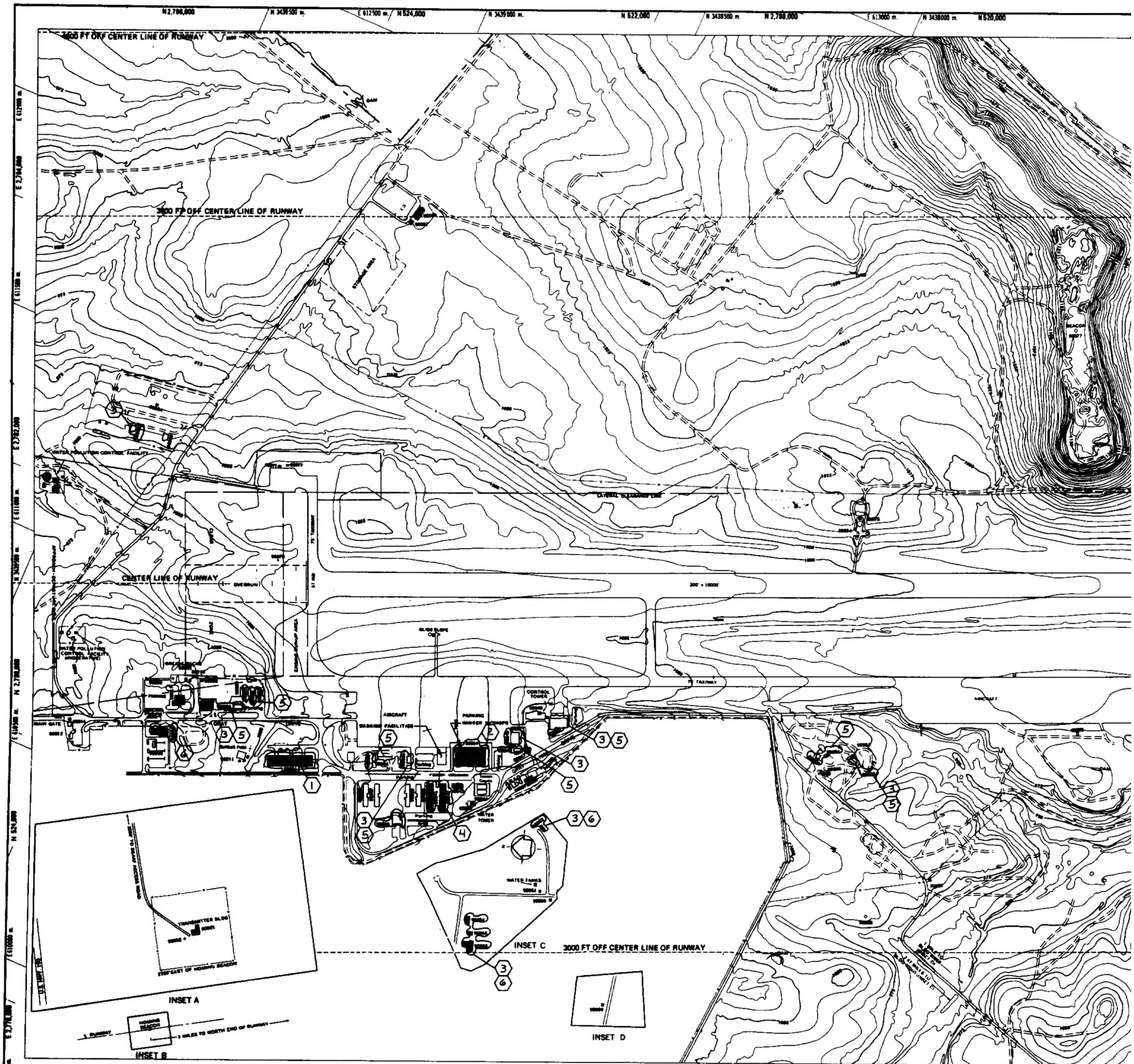
DEC. 1979

1 OF 1



2

CORPS OF ENGINEERS




LEGEND

| ITEM | EXISTING |
|---|---|
| BUILDING, PERMANENT | |
| BUILDING, SEMI-PERMANENT | |
| BUILDING, TEMPORARY | |
| PAVEMENTS (roads, parking, airfields, etc.) | |
| TRAIL OR EARTH ROAD | |
| FENCE, BARBED WIRE | |
| FENCE, CHAIN LINK | |
| RESERVATION BOUNDARY | |
| RESERVATION BOUNDARY | |
| RESERVATION BOUNDARY | |
| RAILROAD | |
| BRIDGE | |
| CULVERT | |
| OUTLINE OF AREA LIMITS | |

| ITEM | EXISTING |
|---|---|
| DAM | |
| SHORELINES | |
| DRAINAGE CHANNEL | |
| MARSH AREAS | |
| CHANNEL LINING | |
| INDEX CONTOUR | |
| INTERMEDIATE CONTOUR | |
| DEPRESSION CONTOUR | |
| NOISE CONTOUR | |
| AIRSPACE CORRIDORS | |

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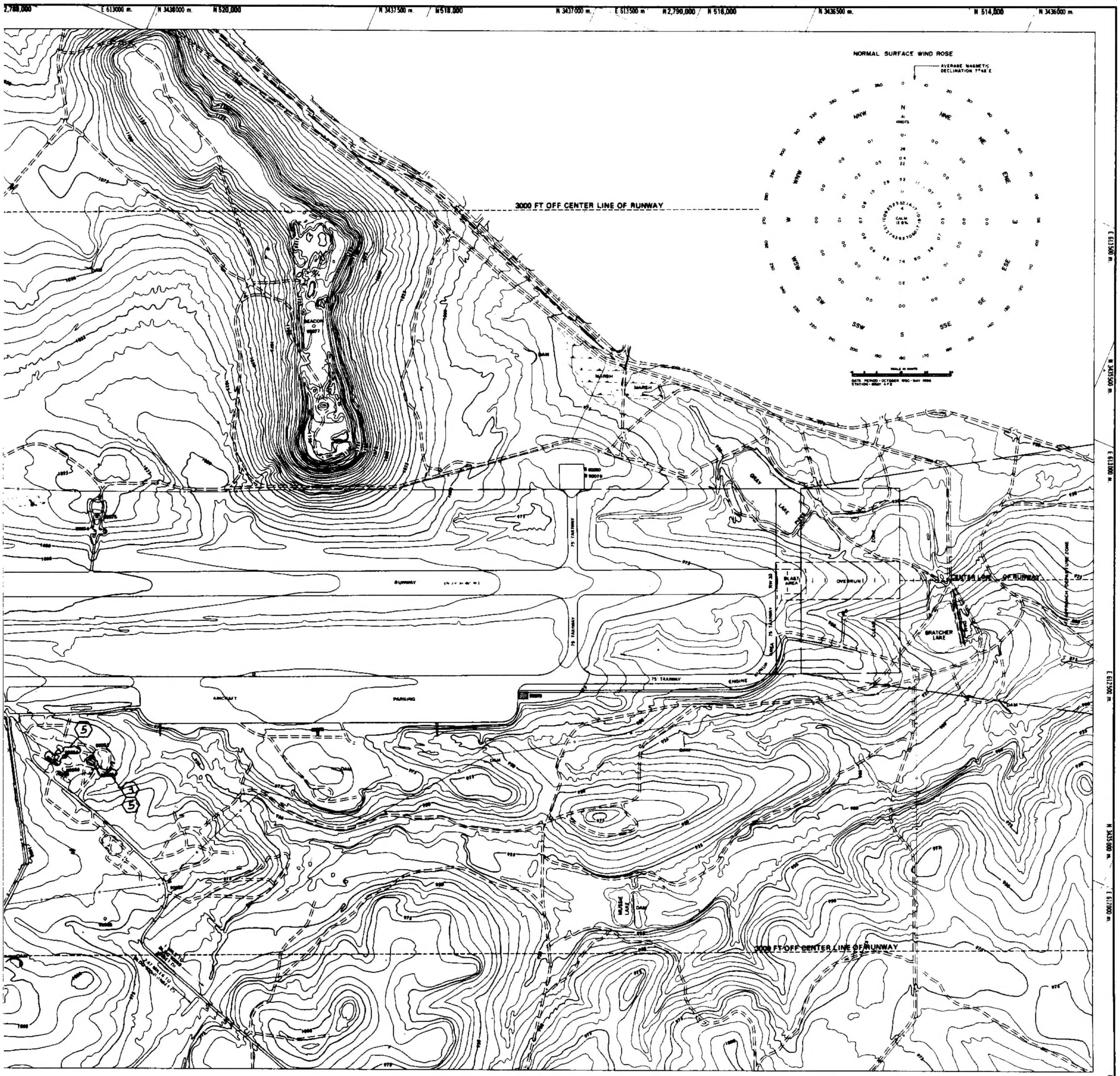
(1)

U.S. ARMY




NS LEGEND

(9) INSTALL OPERABLE STORM WINDOWS WITH HALF SCREENS. WEATHERSTRIP ALL DOORS AND CALK ALL OPENINGS. INSTALL FLOW CONTROL SHOWER HEADS. INSTALL FLUORESCENT KITCHEN LIGHT FIXTURES.

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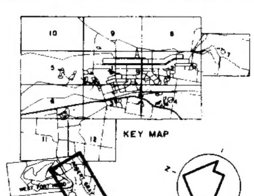


KEY MAP

NOTE:

DUE TO DASA MISSION AIR FORCE CRITERIA WERE USED FOR RUNWAY APPROACH ZONES, CLEAR ZONES AND LATERAL CLEARANCES

SCALE IN FEET AND METERS

UNIVERSAL TRANSVERSE MERCATOR GRID SYSTEM
CONTOUR INTERVAL 5 FEET
500 METER GRID

# FORT HOOD

KILLEEN, TEXAS

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS 76102

MASTER PLAN
BASIC INFORMATION MAPS

## GENERAL ENERGY CONSERVATION MAP

RECOMMENDED BY THE INSTALLATION PLANNING BOARD FOR APPROVAL

DATE

REVIEWED & COMMENTED ON BY MAJOR COMMANDER & FORWARDED TO THE CHIEF OF ENGINEERS

DATE

| DATE | DRAWING NO. |
|---|---|
| DEC. 1979 | |
| SHEET NO. | FILE NO. |
| 1 OF 1 | |



(2)